MINISTRY OF CULTURE · GOVERNMENT OF INDIA
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GOVERNMENT OF INDIA

PHARMACOGRAPHIA INDICA.

A
HISTORY
OF THE PRINCIPAL DRUGS
OF VEGETABLE ORIGIN,
MET WITH IN
BRITISH INDIA.

BY
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OOTACAMUND.

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OPINIONS OF THE PRESS.

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"The 'Pharmacographia Indica,' judging from the first number, will prove to be a work of great utility and a standard reference about the matters it treats."—*Times of India.*

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Wird das Werk so durchgeführt, wie diese erste Lieferung zeigt, so erhält Britisch-Indien ein nicht nur für Medizin und Pharmacie, sondern auch für weitere Kreise in- und ausserhalb jener Länder s
lbuch [illegible] as auch nicht

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in „ Pharmacographia “ indica abgehandelten Pflanzen zeigt, welches unabsehbare Feld wissenschaftlicher und praktischer Aufgaben hier vor uns liegt. Möge es nicht an thatkräftigen Forschern fehlen, welche sich dasjenige zu Nutze machen, was die drei Verfasser hier schon in so grosser Fülle bieten.—*Pharm. Zeitung*.

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,,	36,	17th	,, ,,	,,	*for* Cimifuga *read* Cimicifuga.
,,	79,	3rd	,, ,,	bottom,	*for* 53° *read* 52°·50.
,,	,,	9th	,, ,,	,,	*for* 8 per cent. *read* 5 per cent.
,,	80,	2nd	,, ,,	,,	*for* 3 maunds 26 seers 1 chittack *read* about 3 maunds 35 seers.
,,	149,	11th	,, ,,	,,	*for* of 85° F. *read* at 85° F.
,,	190,	table			*for* 1876 *and* 1877 *read* 1886 *and* 1887.
,,	227,	13th	,, ,,	,,	*for* Hills *read* Hulls.
,,	275,	7th	,, ,,	top,	*for* one-fourth *read* one-tenth.
,,	303,		top of page		*for* RUTACEÆ *read* BURSERACEÆ.
,,	355,	16th	line from	bottom,	*for* natural *read* neutral.
,,	432,	17th	,, ,,	top,	*after* white *insert* or black.
,,	433,	2nd	,, ,,	bottom,	*after* July 27 *insert* 1889.
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,,	,,	9th	,, ,,	,,	*for* Catechu *read* Catechin.

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PREFACE.

THE available information concerning the drugs and medicinal plants of India is scattered through a number of books and periodicals in various languages, as well as official documents, which have only had a very limited circulation.

The authors of the work now presented to the public have endeavoured to collect and verify this information, and supplement it where deficient by original investigation especially directed towards the elucidation of the chemical composition and physiological action of the plants and drugs.

Plants of historical and mythological interest which have long been used in Indian medicine from superstitious reasons, though possessing little or no medicinal activity, have not been omitted, as the history of Indian medicaments would be incomplete without them. In compiling this portion of the work much interesting information has been derived from De Gubernatis' interesting work on Plant Mythology.

In 1883 one of us published a similar work treating of the medicinal plants of Western India and the drugs sold in Bombay, the great drug market of the East. Owing to the rapid increase in the study of organic chemistry during the last few years, much would now have to be added to that work to bring it up to date.

Under these circumstances it has been thought advisable to give a greater scope to the work, so as to include the Materia Medica of the whole of India.

Whilst making these changes several other improvements have been introduced.

To render the work more interesting to the Medical Profession the empirical estimation of the drugs has been compared with the information obtained by modern pharmacological research, and in connection with the principal vegetable poisons toxicological statistics have been introduced.

It only remains for the authors to thank their numerous friends, quoted in the text, who have so kindly rendered willing assistance.

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„ 275, 7th „ „ top, *for* one-fourth *read* one-tenth.

PHARMACOGRAPHIA INDICA.

RANUNCULACEÆ.

ACONITUM FEROX, *Wall.*

Fig.—*Bentl. and Trim., t.* 5, Indian Aconite, Nepaul Aconite (*Eng.*), and one or more other species of poisonous Aconite growing in Northern India.

Hab.—Temperate sub-alpine Himalaya, from Sikkim to Garhwal. The tubers.

Vernacular.—Bish or Bikh, derived from the Sanskrit Visha, Bachnág (*Hind.*), Bachnáb (*Bomb.*), Vashanavi (*Tam.*), Vasanabhi (*Tel. Can.*), from Sanskrit Vatsanábha, Shingadio-vachnág (*Guz.*).

History, Uses, &c.—The greater part of the drug is generally supposed to be derived from *A. ferox*; but we have no very exact information upon this point.

Aconitum luridum, H. f. and *T.*, is found in Sikkim, *A. lycoctonum, Linn.*, from Kashmir. to Kumaon, *A. Napellus, Linn.*, along the temperate alpine Himalaya in four varieties, *viz.*, proper, rigidum, multifidum, and rotundifolium. *A. palmatum, Don.*, in the Eastern temperate Himalaya from Garhwal to Manipur. The last species is considered by the natives of Sikkim not to be poisonous. (*Dr. G. King.*)

Hindu writers mention no less than eighteen kinds of Bish or poison, of which ten are said to be unfit for medicinal use on account of their extremely poisonous properties, which they exaggerate to such an extent as to say that their touch is fatal; of the eight kinds which may be used, that known as Teliya*

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* Teliya applied to drugs means that they have been greased or oiled to preserve them from the action of the air, *e.g.*, Teliya-tankankhár, 'Borax which has been greased to prevent efflorescence.

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Bachnág is said to be the best; it is of a yellowish brown colour, and in shape like a deer's horn. Bish as a name for Aconite appears to have been known to the Hindus from the earliest ages, but the word appears to have been applied also to any very poisonous root. The nine virulent poisons mentioned by Sanskrit writers are certainly not all Aconites, as some of them are described as growing in parts of India in which Aconites are not found; thus it would appear that the Sanskrit Visha, and its equivalent, Bish and Bikh,* in the modern Indian languages, may be understood to mean poison, and especially Aconite as being the most virulent poison known. The non-poisonous Aconites, which are known and used as medicines, have distinct vernacular names. The author of the Makhzan-el-Adwiya and other Arabian and Persian writers describe Bish as an Indian root, and appear to have copied their accounts of it from Hindu books; there is some difference of opinion as regards its properties, some considering it to be cold in the fourth degree, and others hot and dry; the latter opinion seems to prevail, as the drug is recommended in diseases arising from cold humours and atrabilis, and also in leprosy, cough, asthma and ulceration of the throat.† Bish is much used as an external application, the root being formed into a paste (*lep*) and spread upon the skin as a remedy for neuralgia and other painful affections, such as boils, &c.; internally it is prescribed in fever and rheumatism, but is generally mixed with a number of other drugs, both mineral and vegetable; moreover, it undergoes a process of purification by being boiled in milk or cow's urine, which must considerably diminish its activity. In native prescriptions for cough, asthma, and fevers Aconite is combined with borax and aromatics, sulphur and croton seeds are added if there is constipation. The famous Indian pill for snake-bite contains aconite root, white arsenic, yellow arsenic, red arsenic, herb of *Aristolochia*

---

* In Northern India ष is pronounced kh, in Southern India sh.

† In Paris public singers employ with success the alcoolature d'aconit in doses of 10 to 20 drops in a glass of eau sucrée, of which a mouthful is taken occasionally to clear the voice.—(Dorvault.)

bracteata, fruit of *Randia dumetorum* in equal parts. These drugs are rubbed down on a stone with the juice of the Betel pepper-leaf, and made into pills, the size of the seed of *Abrus precatorius* (about 2 grs.). The dose is one pill every five minutes rubbed down with Betel-leaf juice until three pills have been taken. European physicians in India have long been in the habit of using Bish as a substitute for ordinary Aconite root, and it has of late years been used in Europe as a source of Aconitine. As far as our experience goes it is not more dangerous than the mixed roots known in the European markets as German Aconite; a supply of Aconite of known botanical origin is still a desideratum in pharmacy. Modern physiological research shows that Aconite applied externally acts as a local irritant and narcotic, producing numbness and tingling. Introduced into the circulation in large quantity it causes sudden paralysis of the heart-muscle, which appears to be due to the action of the poison upon the vagus roots; smaller, but poisonous doses, cause disturbance of the respiration, muscular weakness, vascular depression, and death. Therapeutic doses cause reduction of the force and frequency of the circulation, muscular inertia, and slight tingling in the extremities or lips. Similar effects are produced in man and in animals. Numerous experiments have been made to ascertain the manner in which Aconite influences the heart, but further investigation is still required to settle this point. Aconite may be used to lower arterial action, and with it excess of temperature in fevers of a sthenic type, to relieve over-excitation of the sensitive nerves, as in neuralgia or rheumatism. It must be borne in mind that its influence upon the motor centres and nerves is much less than upon the sensitive centres and nerves and upon the heart. Atropine and Digitalis have been used with success in cases of poisoning by aconite; they appear to restore the power of the heart by counteracting the effects of the poison upon the vagus roots.

Description.—The fresh root of *A. ferox* has been described by Balfour (*Edinb. New Phil. Journ.*, xlvii., 1849,) from

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a plant growing in the Edinburgh Botanical Gardens, as having 2-3 fasciculated, fusiform attenuated tubers, some nearly five inches long and 1½ inch in circumference, dark brown externally, white within, sending off sparse longish branching fibres. Two kinds of the dried root (Bachnág) are met with in the Indian markets. That in general use consists of black, plump heavy conical tubers, many of them four inches long, having a strong disagreeable smell like Hyraceum, and a reddish brown resinous fracture in dry weather; in the rainy season they become tough, horny and moist, and stain the fingers brown when handled. This kind, even when carefully washed, retains its strong smell, which renders it unfit for medicinal use among Europeans. It appears to be the *Telíya Bachnág* of the books. The other kind, called White Bachnág, exactly corresponds with the description of the Bish imported into England as given in the Pharmacographia. It may have a horny or starchy fracture; in the former case it is more or less shrivelled, from having been exposed to heat, and the starch granules, if examined, will be found altered.

Microscopic structure.—If we examine a transverse section of a tuber which has not been subjected to heat, commencing from the circumference, we see an external brown epidermis composed of compressed cells, among which are some stone cells; next we come to a homogeneous white or yellowish starchy parenchyme, and at a certain distance from the circumference five to six or seven brown vascular bundles, connected together by a brown line composed of a zone of small stone cells; inside this we meet again with a starchy parenchyme; the centre of the tuber is often fissured. In young roots the vascular bundles are nearer the centre than in old ones.

Chemical composition.—For a full account of this, consult *Pharmacographia, p. 9; Dragendorff, Beitrage z. gerichtl. Chem., p. 57-72; Flückiger, Archiv. f. Pharm. B.* 191, *p.* 196; *Groves, Phar. Jour. and Trans.* 1873-74, *p.* 293; *Report on Aconite Alkaloids, by Dr. Alder Wright; Year-Book of Pharm.,* 1881, *p.* 27; *Dragendorff, Analyse chimique de quelques drogues*

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actives, traduit par Morel, p. 13. The following extracts are made from the last-named work :—

"The tubers known as Bish, which have for some time been met with in commerce, contain an alkaloid, which, in its chemical reactions, presents a close analogy with aconitine. I find that the alkaloid of Bish, which has been called nepaline and pseudo-aconitine, can be quantitatively determined by the same process as aconitine, and that it gives the same reactions as that alkaloid. I may mention as a distinguishing character of this alkaloid, its greater solubility in boiling water and its being less soluble in ether and chloroform. I may, perhaps, also mention that unlike the aconitine of Duquesnel, nepaline prepared by the same process is not precipitated by chloride of platinum. Nepaline can be estimated by means of Mayer's solution, one c.c. corresponding to 0·0388 grammes of the alkaloid ; I have obtained from farinaceous Bish extracted by water 1·81 and 1·82 per cent. and extracted by alcohol 1·15 and 1·04 per cent. of nepaline. If the action of the alcohol is prolonged for several days, a better result is obtained."

One litre of Mayer's solutions contains 13·546 grm. of perchloride of mercury and 49·8 of iodide of potassium. Its action is based upon the formation of a double iodide of the alkaloid very sparingly soluble in water, and composed of 1 eq. of iodide of aconitine and 1 eq. of biniodide of mercury.

According to Wright and Luff, the formula for aconitia is $C^{33} H^{43} NO^{12}$, and for pseudo-aconitine $C^{36} H^{49} NO^{12}$.

F. Mandelin (*Archiv. der Pharm., February and March,* 1885,) gives the following as the conclusions he arrives at after a thorough investigation of the subject of aconitine :—

1. Japaconitine is identical with aconitine, and both are identical with a crystalline benzoylaconine.

2. Benzoylaconine is the only active principle of *Aconitum Napellus,* the other alkaloids contained in the plant being amorphous and pharmacologically unimportant.

3. The active principle of the roots of *Aconitum ferox* is however pseudo-aconitine or veratroylaconine.

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4. Aconitine and pseudo-aconitine are pharmacologically identical, but in consequence of its molecules being larger, more veratroylaconine is required to produce the same effects as aconitine.

5. The difference in the toxicological effects of *Aconitum Napellus* and *Aconitum ferox* depends entirely upon the relative amount of aconitine contained in the two plants respectively, and not, as hitherto supposed, upon any difference in the virulence of the active principle of either of them.

6. Aconitine and pseudo-aconitine are the strongest known poisons.

7. The maximum dose to be given at one time would be 0·1 m. g. or 0·5 m. g. per diem. Subcutaneously the dose should be less.

8. Aconine ($C^{26} H^{39} NO^{11}$) and pseudo-aconine, which are probably either identical or homologous, are likewise poisonous, but far less so than their mother alkaloids.

9. Benzoylaconine and veratroylaconine show an interesting chemical and pharmacological analogy to the alkaloids of the atropine group.

10. The aconitine of commerce is either benzoylaconine or veratroylaconine in a greater or less degree of purity; the German and French preparations being benzoylaconine, the English (especially Morson's) veratroylaconine.

11. The cause of the difference in the physiological effects of the various aconitines of commerce depends chiefly upon the relative amount of alkaloidal products of decomposition (aconine or pseudo-aconine) which they contain, and which do not occur only as such, but also in the form of intermediate products of decomposition of aconitine (amorphous alkaloids).

12. Pure aconitine should yield a *colourless* solution with concentrated sulphuric acid, should not turn red on the addition of one or two drops of a concentrated solution of sugar;

the yellow precipitate, formed by adding phosphomolybdic acid to solutions of aconitine, should dissolve in a few drops of ammonia without any blue coloration.

13. Pure aconitine yields no colour reactions, and those formerly suggested were due to impurities.

14. Hübschmann's napelline is no distinct alkaloid, but a variable mixture of aconitine and aconine.

15. Acolyctine and lycoctonine are not identical with aconine (pseudo-aconine). (*See chemical comp. of A. Lycoctonum.*)

16. Aconitine and pseudo-aconitine do not split up in the animal organism, absorption and ejection taking place very quickly.

17. Owing to its virulence, its ready decomposition, and the absence of delicate characteristic tests, the *post-mortem* detection of aconitine as such is very difficult, the symptoms and the condition of the internal organs are chiefly to be relied upon.

Toxicology.—Chevers, on the authority of Wallich, mentions that the Burmese, during their retreat before the British, threw bruised aconite root into a water tank in the hope of poisoning the troops pursuing them. The Aka hill tribes on the frontier of Assam make use of a paste made of Aconite root to poison their arrows. Some of these arrows and the root from which the poison was reported to be obtained were forwarded to the Chemical Analyser, Bengal, in 1884, for examination. Some of the arrow heads were made of iron, others of bamboo; they were covered with a dark brown adhesive mass which gave the flat heads an oval contour, and this material was applied for a distance of nearly two inches down the shaft below the barb. The adhesive material proved to be aconite, and the root stated to be the source of the poison was also aconite, but the species could not to be determined. The coarsely powdered root rubbed up with water formed an adhesive mucilaginous mass in every way like the material found on the arrow heads. It would thus appear that the root contains sufficient intrinsic gummy material to make a paste on being rubbed up with water. (*Rep. Chem. Exam., Bengal, for* 1884.) About the same time that the arrow-heads were being examined, the Chemical Analyser received from Dr. G. Watt a small cane basket, labelled *Mya-mishmi-baibik,* which had been purchased from the Mishmis. The basket contained 130 grms. of what proved to be small aconite roots, which varied in weight from 4·2 grms. to ·5 grms. The species could not be identified. On analysis, the following results were obtained:—

Moisture at 100° C.	...	18·26	per cent.
Alcoholic extract of anhydrous roots	...	47·94	,,
Fatty matter of	do. ...	0·955	,,
Chloroform extract of	do. ...	0·385	,,
Crude aconitine	...	0·887	,,
Aconitine by Meyer's reagent	...	0·777	,,

The pounded root when mixed with water formed a sticky mass well adapted for smearing over arrow heads, for which purpose it is stated to be employed. (*Rep. Chem. Exam. for Bengal,* 1885.)

Cases of accidental poisoning by aconite are occasionally met with arising from the use of the drug by ignorant native doctors as a remedy for fever, &c. Homicidal and suicidal cases are occasionally reported, but are not so frequent as one might expect, considering how readily the drug can be obtained, and how well known are its poisonous properties. Chevers, for example, states that during the ten years ending 1869, only thirty-six cases of aconite poisoning came under the notice of the Bengal Chemical Examiner; and Burton Brown records only nineteen cases in the Punjab in the years 1861—73. The Bengal Chemical Examiner states that the average of five years previous to 1881—82 was 2·4 per cent. in the viscera examined in Bengal. In the same province the number of cases of aconite poisoning were in 1881—82, 3·1 per cent. in 225 viscera examined. In 1882—83, 2·0 in 210; in the remaining nine months of 1883 *nil* in 127; in 1884, 1·8 in 217; in 1885, 1·7 in 234; in 1886, 0·37 in 266; and in 1887, 0·42 in 238.

As regards the percentage of aconite detections in articles suspected to be poisons, the following are the Chemical Analyser's figures for Bengal:—

Average of six years ending March 31st 1883	2·82
Nine months of 1883	2·20
1884	2·10
1885	4·50
1886	3·10
1887	1·10

As a cattle poison aconite is rarely used in Bengal. In Madras aconite was only found in cases in Class A, *viz.*, human cases in which it was suspected that poison had been administered, and in which one or more of the following, *viz.*, viscera, vomited matters and stools were forwarded for examination:—

Year.	No. of cases examined.	Aconite detected.
1882	152	4
1883	123	2
1884	85	1
1885	81	1
1886	84	0
1887	76	4

No aconite detections are recorded in Class B, *viz.*, food and other articles suspected to be poisons.

In Bombay two detections of aconite were made in 1879-80, one in human viscera, and the other in food, the total number of examinations made in the same year being 105. In 1884, two detections were made in a total of 83 examinations, one in human viscera and the other in liquor. Dr. Lyon remarks that aconite (like datura) appears to be occasionally used by native liquor dealers for the purpose of conferring additional intoxicating power on alcoholic liquor, sometimes with fatal results. The Bombay Analyser's reports for ten years ending 1884 show only six cases of aconite poisoning, three of which were accidental.

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In the Punjab Dr. Center reports that aconite is not often used as a poison. The returns show the following percentages: 1879, 1·8 detections in 162 examinations; 1880, 0·5 in 194; 1881, *nil* in 186; 1882, 1·9 in 201; 1883, *nil* in 194; 1884, *nil* in 200; 1885, *nil* in 234; 1886, 0·35 in 272; 1887, *nil* in 228.

In the North-West Provinces and Oudh four detections of aconite were made in a total of 156 examinations in 1879, and in 1882 three in a total of 156. In the other years, from 1879 to 1887, no detections were made. These figures cannot be compared with those from other Provinces, as no distinction is made between human viscera examined and substances suspected to be poisonous. The aconite root usually sold in the plains of India is ill-suited for homicidal purposes on account of its strong byraceum-like odour and dark colour. It is probable that in Eastern Bengal aconite root in its natural condition is more easily obtainable than in other parts of the country. The strong smelling aconite appears to be used chiefly for poisoning tigers and other beasts of prey. Aconite has been detected in cattle poisoning, but its use is extremely rare.

Commerce.—Aconite root (Bachnág) is imported into Calcutta and other Indian markets chiefly from Nipal; the black strong smelling kind is almost exclusively used in this country. Its average price is 9—10 annas a pound. Other Vernacular names for it are Mithabish, Sringibish, and Dagra.

White Bachnág can be obtained for the same price from Calcutta. It appears to have been brought into commerce for export to Europe.

In the Southern Concan *Lagenandra toxicaria* is known as Vatsanábh.

Some parcels of Aconite root met with in the Indian markets are composed of much smaller tubers than those usually seen, and are evidently obtained from a different plant than *A.*

ferox, probably from *A. Napellus**; they have the usual strong hyraceum odour. In Madras it is sometimes mixed with the roots of *Gloriosa superba.*

ACONITUM LYCOCTONUM, *Linn.*

Fig.—*Jacq. Aust.* 4. t. 380. *Royle Ill.* 56. *A. læve.*

Hab.—West temperate Himalaya; Kumaon to Kashmir, Europe, N. Asia. The tubers.

Vernacular.—Khánik-et-zeib (*Arab.*), Bikh (*Hind.*)

History, Uses, &c.—An Aconite called τὸ λυκοκτονον is mentioned by Galen. λυκοκτονος, or the wolf-slayer, was a name given to Apollo, the God who averts evil. Aconite was used by the ancients to destroy wild beasts. Amongst the latter Greeks, Apollo was the Sun-God; for these reasons, possibly, the yellow aconite has been named Lycoctonon.

In 1865, Hübschmann announced that he had discovered in the root and rhizome of *Aconitum Lycoctonum* two new alkaloids, which he named lycoctonine and acolyctine; they differed from one another notably in their solubility in ether and water, lycoctonine being soluble in ether but only sparingly in water, whilst acolyctine was insoluble in ether, but dissolved by water. Hübschmann, however, subsequently stated that acolyctine was probably identical with the napelline he had obtained from *A. Napellus.* Lycoctonine has been examined chemically by Flückiger and by Dragendorff, whilst physiological experiments by Klebs showed that it was much less powerful in its action than aconitine. Schroff, jun., found that different samples of napelline (acolyctine) of commerce varied both in their chemical

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* The Aconite of the Greeks and Romans, the ἀκόνιτον ἑτέρον of Dioscorides is generally considered to be *A. Napellus*; Khanik-el-zeib and Khánik-el-nemir (wolf strangle, and panther strangle) are Arabic names for poisonous Aconites. Ibn Sina says in the Kanun that they kill wild pigs, dogs, tigers and panthers, and are not used medicinally. (*Conf. Dioscorides* iv. 76; *Plin.* 27, 2; *Theophr. H. P. IX.*, 16, 17.

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reactions and in the degree of physiological effect they were capable of producing; lycoctonine was less active. He also pointed out the fact that the presence of these two alkaloids was an insufficient explanation of the powerful toxic action which the root of *A. Lycoctonum* possessed, and thus threw a doubt on their being the only active principles contained in it. In all these physiological experiments, as well as others by Schroff, sen., Buchheim, Eisenmenger, and Ott, the identity of napelline with acolyctine has been assumed: no trial was made with acolyctine prepared from *A. Lycoctonum*. To throw more light upon these matters (*see also Chemistry of A. ferox*), Messrs. Dragendorff and Spohn (*Pharm. Zeitsch. für Russland* xxiii., 313—384), investigated the roots of *A. Lycoctonum* collected in Switzerland in July 1883.

Isolation of the alkaloids.—The method adopted by the authors was Duquesnel's modified as follows:—

Two kilos of the powdered root were mixed with tartaric acid (successive portions of 10 and 5 grains) and exhausted with strong spirit; for this, three macerations sufficed. The tincture was concentrated, mixed with water, filtered, and repeatedly agitated with ether whilst still acid. The ether removed traces of an acid resembling protocatechuic, but benzoic acid could not be detected. None of the acid decomposition-products of the alkaloids presently to be described could be found, a proof that a suitable method of extraction had been adopted.

The liquid, after exhaustion by ether, was made alkaline with bicarbonate of soda, and again agitated with ether, which now removed a quantity of alkaloid. After exhaustion with ether, chloroform extracted a further portion of alkaloid from the alkaline liquid, in which, after this treatment, only traces of alkaloid could be detected.

The ethereal solutions were evaporated to dryness and the alkaloid, in which Hübschmann's lycoctonine was anticipated, was purified by powdering, digesting with ether, evaporating the ethereal solution, and repeating the treatment until the

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alkaloid dissolved easily and completely in the ether. It was finally obtained in the form of a pale yellow resinous mass, yielding a white powder and dissolving completely in dilute acids. No attempt to crystallize it was successful.

The alkaloid dissolved by chloroform was purified by similar treatment with ether, which solvent removed a notable quantity of the first alkaloid. After purification by solution and treatment with animal charcoal, the second alkaloid was obtained in the form of a white or pale reddish powder. Fifteen kilos of the dry root yielded 170 grams. (1·13 per cent.) of alkaloid soluble in ether, and 120 grams. (0·8 per cent.) of alkaloid soluble in chloroform.

Alkaloid soluble in ether.—In this lycoctonine was anticipated, but it was found on examination to differ materially from that alkaloid, especially in being non-crystallizable. As it could not be identified with any known alkaloid, the name of lycaconitine was proposed for it.

Ultimate analysis showed the probable formula to be $C^{27}H^{34}N^{2}O^{6}+2H^{2}O$, the two molecules of water being given off at a temperature of 110° C., at which, however, the alkaloid itself undergoes change. The accuracy of the formula was confirmed by the examination of the salts as well as of the platinum and gold compounds. The latter, and, indeed, the double salts generally, are unstable, suffering partial decomposition when washed with water.

None of the salts could be crystallized, but as they are easily diffusible, they are probably crystallizable.

A ten per cent. solution of lycaconitine in absolute alcohol is dextro-rotatory $(\alpha)_D = +31{\cdot}5^\circ$. After drying in vacuo, lycaconitine begins to melt at 111·7°, and is completely fused at 114·8° (corr.); the alkaloid undergoes, as previously observed, partial decomposition.

The reactions of lycaconitine show but little that is characteristic. With sulphuric acid it gives a reddish-brown solution; sulphoselenic acid is coloured rose or pale reddish-violet; this reaction is not exhibited by aconitine, nepaline, or commercial lycoctonine. Syrupy phosphoric acid yields, with lycaconitine, a violet solution when warmed. Lycaconitine is incompletely precipitated by caustic potash, ammonia, and alkaline carbonates; strong alkalies partially decompose it.

The foregoing details suffice to show that lycaconitine is not identical with Hübschmann's lycoctonine or acolyctine, nor with aconitine or nepaline, or indeed with any known alkaloid.

Alkaloid sparingly soluble in ether.—This alkaloid, extracted with chloroform, after the separation of the lycaconitine by ether, differs so strikingly from Hübschmann's acolyctine that the possibility of identity appears to be excluded. It was named myoctonine, in reference to a species of aconite, myoctonon, mentioned by Pliny. It is amorphous, and the salts it forms could not be crystallized. Analysis showed the formula of the alkaloid after drying over sulphuric acid to be $C^{27} H^{30} N^{2} O^{8}$, and the correctness of this formula was confirmed by an examination of the salts. Bisulphide of carbon, absolute alcohol, benzol, and chloroform dissolve the alkaloid in almost any proportion. The taste is bitter, not pungent. It is dextro-rotatory, melts at 143° to 144°, and gives a precipitate with alkaloid group-reagents, but yields no characteristic colour reactions.

Warmed with 4 per cent. solution of caustic soda, myoctonine decomposes, like lycaconitine, into lycoctonine, lycoctonic acid, an alkaloid resembling acolyctine, and a fourth body the nature of which could not be ascertained. From this it is evident that the long-continued heating with carbonate of soda, to which Hübschmann subjected the alkaloids originally present in the root, converted them into lycoctonine and lycoctonic acid; one or other of these then probably yields acolyctine by further decomposition. Physiological experiments with lycaconitine and myoctonine conducted by M. Salmonowitz showed the latter to be a powerful poison resembling curare in its action, and acting most energetically when introduced directly into the circulation. The sub-

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cutaneous injection of 0·075 gram. of nitrate into a cat produced distinct toxic symptoms, and the injection of 0·1 gram. was always followed by death in twenty to thirty minutes. Mice were killed by one milligram in three minutes. Lycoctonine and lycaconine, the decomposition-products of lycaconitine and myoctonine respectively, were found to resemble the original alkaloids in their physiological action, but to be less powerful. (*Year-Book of Pharm.*, 1885.)

ACONITUM HETEROPHYLLUM, *Wall.*

Fig.—*Bentl. and Trim., t.* 7.

Hab.—West temperate Himalaya from Kumaon to Hansora. The tubers.

Vernacular.—Atís (*Hind.*), Ativish (*Mar.*), Ati-vadayam (*Tam.*), Ati-vasa (*Tel.*), Atavakha-ni-Kali (*Guz.*).

History, Uses, &c.—The earliest notices of Ativisha* are to be found in Hindu works on Materia Medica, Sárangadhara and Chakradatta, where it is recommended as a remedy in fevers, diarrhœa, dyspepsia and cough, also as an alexipharmic; those in Arabic and Persian works are short, and apparently copied from them; they direct it to be prescribed in combination with aromatics, astringents and sometimes with other bitters, such as Bonduc-nuts, Tinospora, Holarrhena, &c. It is an ingredient in *Bál-goli*, a pill given to infants to keep them quiet, which contains thirty-one drugs, of which *three are narcotics, viz.*, Bhang, Opium and Datura, and the remainder bitters and aromatics. This pill is sold by all the native druggists, and, it need hardly be said, is most fatal to children. The author of the Makhzan-el-Adwiya calls Atis an Indian root, resembling a small specimen of *Aristolochia longa*, and says that some authorities describe three kinds, *viz.*, Atís, Part-bikhta, and Shámkand; but others only two kinds—white and black. He says it is aphrodisiacal and tonic, checks diarrhœa, and removes corrupt bile and cold humours and the diseases arising from them.

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* Ati-visha, counteracting poison.

The early English physicians in India appear to have been chiefly impressed with its antiperiodic and tonic action in fevers, and the drug has until quite a recent date been much administered as an antiperiodic in doses of about 30 grains every four or six hours. The discovery that the active principle, Atisine, is only present in very small quantities in Atís, seems to have brought the drug into discredit, and the European demand for it has much fallen off. The evidence collected by Dr. G. Watt for his Dictionary of the Economic Products of India indicates that Atís is now considered an indifferent antiperiodic by medical men. Dr. M. Sheriff considers that the ordinary doses are only useful as a tonic, and that two drams or more should be given as an antiperiodic. Probably the native estimate of the drug, as given above from the Makhzan, is not far from the truth, *viz.*, that it is tonic and digestive and often useful in dyspepsia with diarrhœa.

Description.—The drug, as sent into commerce, may be divided into two portions, grey and white; the grey shrivelled tubers, which are larger and longer than the white, are the mother roots, and are often separated and sold at a lower price. The young daughter-tubers should be quite plump, externally of a pale ash colour, slightly scarred from the abrasion of rootlets, from ¾ to 2 inches long, obconical, or almost ovoid, with a thin tap-like extremity, which is sometimes double, or has a tendency to divide; at the summit there is a scaly leaf-bud. Atís should break with a short starchy fracture, presenting a white surface, near the circumference of which several vascular bundles are observable with the naked eye; it should taste purely bitter, and have no particular odour.

Microscopic structure.—The tubers consist of a delicate cellular parenchyme filled with starch, in which are to be observed about four vascular bundles, which, in the young tuber, are near the centre, but subsequently are removed towards the circumference. The epidermis consists of light

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brown tabular cells; the brown zone seen in Aconite is not present.

Chemical composition.—The authors of the Pharmacographia, upon the authority of Broughton, state that the root contains a well-defined alkaloid of intensely bitter taste, Formula $C^{46} H^{74} N^2 O^5$ obtained from concurrent analyses of a platinum salt. Wright (1878) percolated the powdered dry root with alcohol containing a little tartaric acid, and evaporating the percolate he obtained ultimately Broughton's alkaloid *atisine.* This was uncrystallizable, but with hydrochloric acid and gold chloride, he obtained a crystalline hydrodichloride, $C^{22} H^{31} NO^2 HCl, AuCl^3$, from which he suggests that $C^{22} H^{31} NO^2$ may prove nearer the correct formula for atisine than that given by Broughton. Atís has recently (1879) been examined chemically by Wasowicz. The general results of his investigation are: that he found the root to contain—(1) a fat of soft consistence, probably a mixture of oleic, palmitic, and stearic glycerides; (2) aconitic acid; (3) an acid related to ordinary tannic acid; (4) cane-sugar; (5) vegetable mucilage; (6) pectous substances; (7) atisine, the alkaloid already observed by Broughton, and probably another uncrystallizable alkaloid; (8) starch. The root contained 2·331 per cent. of ash that dissolved partly in water and partially in dilute hydrochloric acid. Experiments made in administering the alkaloid to rabbits show that it is not poisonous. The quantity in the root is exceedingly small ($\frac{6}{100}$ of 1 per cent.). The purified alkaloid is white and uncrystallizable; of its salts, only the hydrochlorate, hydrobromate and hydriodate are crystallizable. (*Archiv. der Pharmacie,* Vol. XI., p. 19.) Atisine when dissolved in sulphuric acid gives a purple colour, a reaction which has been observed by E. Z. Gross with coptine obtained from *Coptis trifoliata*; and with hydrastine, one of the alkaloids of *Hydrastis canadensis,* plants belonging to the same natural order.

Commerce.—Atís comes into the plains through the principal towns of Northern India; it would appear that in some parts

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of Southern India other roots are sold as Atís. (*Pharmacographia*, p. 15.*) The average price is Rupee ¾ to 1 per lb.

ACONITUM PALMATUM, *Don.*

Hab.—Temperate Himalaya from Sikkim to Garhwal, Mishmi. The tubers.

Vernacular.—Bikhma, Bishma (*Hind.*), Wakhma or Vakhma (*Bomb.*).

History, Uses, &c.—It is impossible to trace the history of this drug in Indian and Persian works on Materia Medica, though doubtless it is one of their non-poisonous kinds of Bish. The author of the Makhzan-el-Adwiya notices it as a non-poisonous kind of Bish, and says it may be prescribed in the same manner as Atís. In English works upon Indian drugs, it appears to have almost escaped attention. Dr. Buchanan, in his account of the Kingdom of Nepal, enumerates four kinds of Bikh, of which Bikhma is one; he describes it as a powerful bitter: it is a rare drug in most parts of the country. Bikhma is intensely bitter, like quinine, and is administered by Native doctors in combination with black pepper, or mace, in doses of about eight grains, as a remedy for pains in the bowels, diarrhœa, and vomiting; also to destroy intestinal worms and to remove costiveness. Externally it is applied in rheumatism. From its sensible properties we may conclude that it would be likely to prove a valuable tonic and digestive; but unless it is much more powerful than Atís, its high price and rarity will prevent its general use.

Description.—Tuberous roots of a light brown colour, 2 to 4 inches long, much resembling some samples of horny and farinaceous Bish in structure, *but differing from them in being*

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* The rhizome of *Cryptocoryne spiralis*, which has lately attracted attention by being offered for sale in London as a kind of Ipecacuanha, is the root referred to; it is known in Madras as Náttu-ati-vadayam or country-atís. (*Lawson.*)

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branched. The tubers break with a short fracture, and the inner substance is either white and farinaceous, or horny and yellowish; both kinds of tuber have a pure persistent bitter taste and no acridity; the horny tubers when moistened develop a pungent smell like nasturtium.

Microscopic structure.—The tuber is composed of a starchy parenchyme, with from 6—12 bundles of scalariform vessels; in young roots these are crowded together towards the centre, but in more mature ones they are nearer the circumference; there is no brown zone connecting the vascular bundles.

Chemical composition.—Bikhma has been examined in Prof. Flückiger's laboratory by Mr. Yünichiro Shimoyama, who reports as follows:—"Ten parts of the powdered tubers with one part of slaked lime and about 100 parts of water were dried. The dried powder was repeatedly extracted by a sufficient quantity of strong alcohol, and the latter removed by distillation, to the residue a little acetic acid and water was added to get rid of resinous matters. The filtrate was further purified by means of ether, and the alkaloid precipitated from the acetic solution by adding caustic lye. By repeating the same treatment the alkaloid was at last obtained as a perfectly white amorphous powder of decidedly alkaline reaction, and a very persistent purely bitter taste. The alkaloid dissolved in excess of hydrochloric acid, yielded needle-shaped crystals of the hydrochlorate, which were not produced when a neutral solution was used. The hydriodate was also found to be crystallizable, but not the picrate, chromate, or iodohydrargyrate. The aqueous solutions of the alkaloid were precipitated by bichloride of mercury and by tannic acid, not by iodide of potassium. The alkaloid was found to be readily soluble in alcohol, chloroform, bisulphide of carbon, benzol and ether, but none of these solutions afforded crystals; it was dissolved by concentrated sulphuric acid, and the yellowish solution gradually assumed a splendid purple colour, lasting for a day or more; it turned violet on addition of a few drops of water. If the alkaloid is evaporated at 100° C. with phosphoric acid, a fine violet hue is also produced."

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Prof. Flückiger remarks:—"The alkaloid which Wasowicz extracted from *A. heterophyllum* in my laboratory is the same as that yielded by the Wakhma tubers."

Commerce—Bikhma is brought in small parcels to the Indian cities by religious mendicants. Value Rs. 2 to Rs. 6 per lb. according to the quantity in the market.

JADWAR.

The great purifier, or antidote. Arabic form of the Persian Zadwár زدوار quasi زدای وار In Ætius the Greek form is *ζέδοαρ* and Myrepsus writes *τζετὸυαριον*. The Persian plant is also called Mah-parwin (Moon and Pleiades), probably because it blossoms in the beginning of summer when the Pleiades rise. Macer calls it Zedoar,—

> "Adprimè sumptis zedoar obstare venenis
> Affirmant."

History, Uses, &c.—The history of this drug is beset with many difficulties, on account of the vague meaning of the term Jadwár; the name by which it is generally known, and which appears properly to mean the great antidote. Under Jadwár, the author of the Makhzan-el-Adwiya gives Antila as the Arabic name, and Sáturyús* as the Greek. Speaking of Bísh he says that the Hindus suppose that the only plant which can grow near it is the Jadwár, which is an antidote to it, and that they also affirm that there is a kind of rat, called 'Bish mush bisha,' which lives upon Jadwár, and is an antidote to Bish; this is the Búka·Bish Mush of Ibn Sina.

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* Dioscorides describes two kinds of *σατύριον* (III. 134-135), both reputed to be aphrodisiacal; see also Pliny on Satyrion (26, 62, 63). Apuleius Platonicus says of Satyrion: Alii cinos, alii panion, Galli via, a Græcis satyrion, alii ennaticon, alli serpinon, Itali priapiscum, Ægyptus oreisalitexion, alii criton, alii mene, alii torminalis. Neophytus speaks of *ἀντουρα* as an antidote; speaking of Zedoar he says *ἔοικε δὲ ξηρῳ καὶ μέλανι μικρῳ καστάνῳ.* (It is like a small, dry, black chestnut.) Barbosa mentions Zedoaria and Zeruban as two distinct drugs on sale at Cannanore. (Cf. *Salmasius de Homon. sub vocé Gedwar.*)

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The Indian name Nirbishi he explains incorrectly as Nir, the antidote to Bish, the poison*; he describes five kinds :—

"1*st*—Khatai, black externally, purplish brown internally, scorpioid, knotted, tasting sweetish at first, afterwards very bitter.

2*nd*—Outside and inside brown, or yellowish brown.

3*rd*—Outside and inside black; when rubbed down it has a purplish tinge, bitter. This and the second kind come from Thibet, Nipál, Morang and Rangpore. (These three kinds are probably the roots of some kind of Aconite or Delphinium.)

4*th*—Blackish, bitter, size of an olive, comes from the Deccan hills, probably the tuber of a Curcuma. (The Gedwar figured in Clusius' Exotica, p. 378, appears to be of this kind.)

5*th*—Spanish, called Antila, black, soft, very bitter (ἀντουρα probably *Aconitum Anthora*)."

Of these, the first kind is said to be most esteemed. It would appear, then, that the term Jadwár has at different times been applied to various tuberous roots supposed to have alexipharmic properties, and that in India it is now applied to the root of a Delphinium or Aconite, at present known to the Hindus as Nirbishi, a term which, like Jadwár, has at different times been applied to very different plants. Royle tells us that the best Nirbisi is brought down from Bissehar and Amritsar, and is fusiform, and resembles Bikh; when cut it is of a brownish colour and slightly bitter and acrid. Aitchison says that *Jadwar-i-Khatai* is the name in Leh for the root of an Aconite imported from Nipal *via* Lhassa. It is called in the Punjaub *Nirbisi*, by Bhoteas in Leh *Bonga*, and by the Yarkandis *Farfi*; it is poisonous, and is administered in cases of poisoning and in severe illness, such as cholera, and is carried as a talisman about the person. Ulasr Muharrir says that false Jadwár is prepared by boiling the roots of some of the milder kinds of Bish in milk, and colouring them; it is to be distinguished from genuine by its parting with its colour when dipped in warm water and wiped with a cloth; it has also a shrivelled appearance, and the central portion to which the colour has not penetrated is pale; instead of being intensely bitter, it is slightly acrid.

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* Nirvisha is a Sanskrit adjective meaning "not poisonous," and nirvishâ or nirvishi is never applied to aconite by medical writers, but denotes a peculiar grass, used as an antidote to certain poisons, namely, *Kyllingia monocephala, Linn.*—(*Dr. Rice.*)

Native medical works abound in absurd stories concerning this article, and its wonderful power as a tonic and alexipharmic; it fetches a high price, and is generally kept in metallic mercury to prevent its being injured by insects; sometimes it is preserved in oil.

Jadwar appears to resemble much the Tienhiung of the Chinese, which is said by Dr. Porter Smith to be derived from *Aconitum variegatum.* Like Jadwár, this drug is blackish-brown internally, and more or less moist, having evidently undergone some kind of preparation. Dr. Morrison, Medical Officer to H. M.'s Consul at Newchwang in Manchuria, mentions in a recent Consular report that Manchuria exported in 1884, 13,866 lbs. of the roots of *Aconitum Anthora, barbatum,* and *Fischeri* (?) for use in medicine on account of their stimulant, diuretic and alterative properties.

Description.—What is considered now to be genuine Jadwár in India consists of small blackish-brown tubers, some irregularly ovoid, some conical, seldom more than one inch long and half an inch in diameter; they are somewhat wrinkled, and bear a few horn-like projections, which are the remains of rootlets; at the crown there is a scaly leaf bud. When in good condition the tubers are softish, and cut like a piece of dry liquorice extract, the colour being a uniform dark brown throughout; to the naked eye the cut surface appears structureless, and might be mistaken for an extract; it has a somewhat fruity smell and bitter taste.

Microscopic structure.—A transverse section shows a dark brown epidermis, composed of compressed cells, an outer ring of parenchyme, the cells of which contain starch granules and much brown granular matter; within this are from 5 to 10 vascular bundles, connected together by a cambial zone, made up of several rows of small, dark brown cells; the position of the bundles is very irregular, consequently the zone has a peculiar waving course. In the central portion of the tuber starchy parenchyme is again met with; the starch has not been altered by heat.

Chemical composition.—Twelve ounces of the roots treated by Dragendorff's process for aconitine, yielded no trace of alkaloid upon evaporation of the benzine solution. The treatment of the drug by acidulated water extracted a large quantity of black extractive which was almost entirely soluble in alcohol. It seems probable that the roots undergo some form of preparation during which they are charged with foreign extractive matters, and probably rendered almost inert as a medicine.

Commerce.—Jadwar is brought for sale to the Indian cities in small parcels by religious mendicants.

DELPHINIUM ZALIL, *Aitch. et Hemsley.*

Fig.—*Trans. Linn. Soc. Ser. 2. Bot. Vol.* iii., *Pl.* 3.

Hab.—The Badghis and Khorasan. The herb.

Vernacular.—Zarir (*Arab.*), Zalil, Asfrak, Asperag (*Pers.*), Tráyamán, Gul-jalil (*Bomb.*), Gáfiz, (*Punj.*).

History, Uses, &c.—In Hindu medical works a drug called Tráyamána is frequently mentioned as a remedy for enlargement of the abdominal viscera; it appears to have been well-known, as it has numerous synonyms such as Baládeva, Balábhadra, Mangalya, Mángalyarha, and Arjaka, signifying that it was considered to be very auspicious.* The same name is still current in Northern India and Guzerat to indicate the drug imported from Persia under the name of Zalil, and described in Mahometan works on Materia Medica as Zarir. In Bengal and Southern India the drug is unknown, and *Ficus heterophylla, Linn. fil,* is used as a substitute for it under the names of Balábahula and Valli-teragam. The author of the Makhzan-el-Adwiya says :—" Zarir grows in the Khorján hills and is called Asfrak by the people of Shiráz, and Arjikan by the Greeks*; the stem is about a span high, flowers yellow, like those of Asfar-i-barri, surrounded by a few soft prickles, leaves yellowish, small, root more than a span long. Asfrak is cold and dry with slight heating properties ; also detergent, anodyne and diuretic ; it is useful in spleen, jaundice and dropsy ; mixed with barley meal, it forms a poultice, which is of much service in inflammatory swellings ; its ashes are useful in itch. Maximum dose 5 dirhems† ; it is also used as a yellow dye." In India and Persia it is now chiefly used for dyeing silk. Edgeworth brought this drug to notice many years ago, and supposed it to be derived from *D. altissimum.* The true plant has been discovered by Aitcheson in the moister localities of the Badghis and Khorasan at an altitude of 3,000 feet. He says that when in flower it gives a wondrous golden hue to the pastures. (One of the Sanskrit synonyms is Sita or moonlight.)

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* Yellow is a most auspicious colour amongst the Hindus, the garments of the bride are dyed of this colour. The word Tráyamana still exists in the Persian language, with the meaning of "yellow" and "diarrhœa."

Description.—The drug consists of the flowers, leaves, flower stalks, and a small proportion of the immature fruit, all of a light greenish yellow colour, and having a somewhat honey-like smell ; the flowers are pubescent ; many of them tolerably perfect, resembling in size and shape those of the common single Larkspur ; the fruit consists of three follicles, which are arranged like those of the aconite and dehisce on the inside ; they are marked with prominent longitudinal ribs, have pointed apices, and are supported upon a stout curved peduncle ; the seeds are numerous, angular, and of a light-brown colour. The drug when placed in water immediately tinges it a bright yellow, and communicates a bitter taste to it.

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* Arjikan is apparently the Sanskrit word अर्जक.

† Five dirhems—240 grains in 24 hours in decoction. A reference to the chemical composition will show that this dose may possibly prove dangerous.

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Microscopic structure.—The seeds are thickly set with white feather-shaped hairs, arranged in rows.

Chemical composition.—The drug reduced to powder lost 23·5 per cent. of moisture when heated to 100° C. The ash amounted to 17·8 per cent. Treated with 94 per cent. alcohol 13·4 per cent. of a dark reddish, bitter, acid extract was obtained. The extract was mixed with water acidulated with hydrochloric acid, and repeatedly agitated with ether. During agitation, blackish resinous matter separated, while the ether became turbid from the separation of a white principle.

On filtration of the aqueous solution 2·6 per cent. of a dark resinous body was obtained, which was soluble in ammonia to the extent of 2·54 per cent. The ammoniacal solution was of a dark brown colour, the addition of acids caused the precipitation of dirty yellowish flocks; this principle had the properties of an acid resin. The residue insoluble in ammonia amounted to ·06 per cent., and was white; it was not further examined.

The ethereal solution after filtration yielded 1·63 per cent. of extractive, the residue on the filter was white, and had the physical characters of the principle left after the action of ammonia on the black resin already mentioned. The ethereal extract was redissolved in ether, and agitated with ammonia. On separating the ether, it left on evaporation ·69 per cent. of a greenish-yellow oily residue, from which a white crystalline principle slowly separated. This crystalline principle will be referred to again. The ammoniacal solution yielded with acids brownish-yellow flocks, which had the properties of an acid resin; this principle would appear to be similar to the dark resin left as a residue after agitation of the original aqueous solution with ether.

The original aqueous acid solution left after separation of the ether was repeatedly agitated with amylic alcohol. The separated amylic alcohol was agitated with ammonia, which became coloured of a deep yellow hue; on separating the

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NIGELLA SATIVA, *Sibthorp.*

Fig.—*Zorn. Ic.* 119. Small Fennel-flower (*Eng.*), Nielle, Toute épice (*Fr.*).

Hab.—The Mediterranean countries. Cultivated in India.

Vernacular.—Kalajira, Mugrela (*Hind., Beng.*), Kalonji (*Bomb.*), Karun-shiragam (*Tam.*), Karijirigi (*Can.*), Nallajilakara (*Tel.*), Kalejiré (*Mar.*), Shuniz, Siyah dánah (*Pers.*).

History, Uses, &c.—According to Birdwood, it is the Black Cummin of the Bible, the Melanthion of Hippocrates and Dioscorides, and the Gith of Pliny.* Ainslie mentions its use as a carminative, also as an external application mixed with sesamum oil in skin eruptions, as a seasoning for food, and as a protection for linen against insects. Forskahl, in his Medicina Kaharina, says that it is a native of Egypt, where it is called Hab-és-souda.† Roxburgh believes it to be a native of Hindostan. Anyhow, it must have been long known in India, as it has a Sanskrit name, Krishnajiraka. Nigella seed is extensively used as a spice, and as a medicine; it is prescribed by the Hindus with other aromatics and plumbago root in dyspepsia. The Hakeems describe it as heating, attenuant, suppurative, detergent and diuretic, and consider that it increases the menstrual flow and the secretion of milk; also that it stimulates uterine action. They give it, too, as a stimulant in a variety of disorders which are ascribed to cold humours, and credit it with anthelmintic properties. It is sprinkled over the surface of the bread made by Mahometan bakers along with Sesamum seed. (*See Cuminum Cyminum.*) M. Canolle has recently published (*De l'avortement criminel*

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* Plin. 19, 52, 20, 71; Cels. 2, 34; Scrib. Comp. 131.

† الحبة السود El-habbat-es-souda, i.q., الشونيز El-shooniz, or properly الشينيز El-sheeniz, for thus the Arabs called it according to Ibn-el-Aarabi, or, as some say, i.q., الحبة الخضرا El-habbat-el-khizra, because the Arabs often call black اخضر and green اسود. This seed is said in a tradition to be a remedy for every disease except death. (*Madd-el-Kámus.*)

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à Karikal. Thèse de Paris, 1881,) the results of clinical investigations undertaken in the hospital at Karikal with black cummin seed. He has observed that after doses of 10 to 40 grams of the powdered seed the temperature of the body is raised, the pulse accelerated, and all the secretions stimulated, especially those of the kidneys and skin; in doses of 10 to 20 grams. they possess a well marked emmenagogue action in dysmenorrhœa, and in larger doses cause abortion.

Description.—The seed is triangular, the umbilical end being smaller than the other, black, ⅛th of an inch long, testa rough; inside the testa is a white oily kernel. When rubbed, the seed diffuses a pleasant odour of lemons, with a slight *soupçon* of carrot.

Chemical composition.—The seeds of *Nigella sativa* have been analysed by H. G. Greenish (*Phar. Jour.* (3) X., 909 and 1013), with the following results:—One hundred parts of the seeds contain: Moisture 7·43, Ash 4·14, Fixed oil 37·00, Volatile oil 1·64, Albumen (sol. in water) 8·22, Mucilage 1·90, Organic acids ppt. by Cu. 0·38, ditto by Pb. 0·59; Sugar (Glucose) 2·75, Arabic acid (?) 3·21, Undetermined substance 1·79, Albumen (sol. in soda) 2·14, Metarabin 1·36, other substances dissolved by soda 5·38, Melanthin 1·41, Traces of oil, &c., removed by Alcohol 0·53, dissolved by Chlorine water and Sulphuric Acid 3·85, removed by Chlorate of Potash and Nitric Acid 7·52, Cellulose 8·32—total 99·56. *Melanthin* bears a close analogy to helleborin; like saponin, it possesses considerable emulsifying powers. Greenish has also obtained melanthin from all the aerial parts of *N. sativa*, but found it absent in the roots at all periods of their growth.

Commerce.—The Indian market is supplied from Northern India, Basara, and Cabul. Price 2 annas per lb.

PÆONIA OFFICINALIS, *Linn.*

Fig.—*Bot. Mag.*, *t.* 1784. Officinal Peony (*Eng.*), Pivoine officinal (*Fr.*).

amylic alcohol, it left on evaporation ·51 per cent. of a neutral, yellow, transparent principle insoluble in alkaline solutions. This principle was not further examined. The deep yellow ammoniacal solution yielded yellow flocks on the addition of acids, which were redissolved on agitation, the resulting solution being of a dirty brown colour; the addition of alkalies again caused the liquid to assume its original deep yellow colour. This principle had the properties of an acid, and will be referred to subsequently. The amylic alcohol extract also afforded evidence of the presence of a tannin, which gave with erric chloride a deep greenish coloured solution.

The original aqueous acid solution was now rendered alkaline by ammonia and agitated with ether. The separated ether had a marked blue fluorescence, on evaporation a slightly yellow transparent varnish-like residue was left, soluble in acids, the resulting solution possessing a bitter taste. Alkalies caused the precipitation of white flocks easily soluble in ether, and precipitates were obtained with all the alkaloidal reagents; no distinctive colour reactions were yielded. The crystalline principle referred to as occurring in the ether extract obtained from the aqueous acid solution of the extract had the same properties as the alkaloid now described, indicating that the principle was separable by ether both from an acid and alkaline solution. The alkaline original aqueous solution was now agitated with amylic alcohol; the separated amylic alcohol left on evaporation a yellow residue, which was partially soluble in acids. After filtration to separate insoluble matter, the clear aqueous solution yielded yellowish flocks with alkalies, insoluble in ether, but dissolved by amylic alcohol. The solution of the principle in acids had a yellow colour and was bitter to taste, and gave a precipitate with the ordinary alkaloidal reagents; some of the colour reactions were similar to those yielded by berberine. Regarding the nature of these two bitter alkaloids, though they afforded reactions with reagents which were not inconsistent with their being delphinine and berberine respectively, but

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without data regarding their ultimate composition, it would be premature to definitely designate them.

The yellow acid separated by amylic alcohol is of interest, because to its presence the tinctorial value of the drug as a dye-stuff is doubtless due. In order to obtain the acid in a pure state the following method was tried:—A concentrated aqueous solution of the plant was precipitated with lead acetate, and the yellow precipitate well washed by decantation. The washed precipitate was diffused through water acidulated with hydrochloric acid, and the separated chloride of lead removed by filtration. The yellow solution was agitated with amylic alcohol; on evaporating off the amylic alcohol a deep yellowish red extract was obtained, easily soluble in water, and possessing a marked acid reaction. The addition of acids caused the precipitation of yellow flocks, soluble on agitation; the addition of alkalies caused the liquid to assume a deep yellow colour. The aqueous solution gave a dirty olive-green coloration with ferric chloride, due probably to the presence of a trace of tannin. The aqueous solution agitated with water acidulated with sulphuric acid in a sealed tube at 100° C. for some hours afforded a turbid solution, which contained dark brown flocks, and which precipitated an alkaline solution of copper on boiling.

The principles separated from the drug may be arranged as follows:—

Dark acid resin.
White neutral principle.
Yellow neutral principle.
Colourless bitter alkaloid.
Yellow bitter alkaloid.
Tannin.
Yellow acid.

Commerce.—Trayamán or Gul-jalil is imported into Bombay and Northern India from Persia, and is of some importance as a yellow dye for silk. It is worth about Re. ½ per lb.

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Hab.—*Europe.* The tubers.

Vernacular.—Úd-sálap (*Hind.*), Ude-sálam (*Bomb.*).*

History, Uses, &c.—This drug is the female Peony of Dioscorides, and was esteemed by the ancients as a valuable remedy in uterine obstructions, colic, bilious obstructions, dropsy, epilepsy, convulsions and hysteria: Dioscorides describes two kinds of Peony, male, *P. corallina*, and female, *P. officinalis*, † these are the two kinds of Fawánia described by Arabic and Persian writers. Galen describes its acrid qualities and emmenagogue virtues, and its use as an astringent in diarrhœa. According to Pliny, the name Pæonia is derived from Pæon, the physician of the gods, who was the first to discover this plant. Hippocrates mentions the use of the seeds in uterine obstructions. The roots of *P. corallina* are turnip-shaped and about as thick as the thumb; those of *P. officinalis* consist of oblong tubercles attached by a stout fibre to a rhizome. The plant and roots are figured by Guibourt (Vol. III., p. 763). Úd-sálap is used by the natives as a blood-purifier for children. In the time of Galen a superstition prevailed that Peony root enclosed in a bag and hung round a child's neck both prevented epileptic attacks and cured them, and this belief is not extinct among the peasantry of Europe even now; they also believe that wearing the seeds will prevent the dangers of dentition. Macer Floridus (*De Vir. Herb.*) says:

> 'Illius radix, pueris suspensa caducis,
> Non modicum prodest, Galienus ut asserit auctor.'

The plant has been proved not to be inert; it produces headache, noise in the ears, confused vision, colic and vomiting if taken in full doses (60 grs.). Modern observation has neither confirmed nor condemned the ancient opinions concerning it; and although some have reported favourably of it

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* Corruptions of عود الصليب (Aod-el-salib) or '*wood of the cross*,' an Arabic name for the root of *P. corallina*, because on section it shows two lines crossing one another, which are not seen in the female Peony.

† Dios. iii. 148; Plin. 25, 10, 27, 60.

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in epilepsy, chorea, and whooping cough, the evidence in favour of its efficacy is very slender.

Description.—The dried tubers are from 1 to 3 inches in length, and ½ inch to ¾ inch in diameter, tapering to a point at both ends; the external surface is brown and channelled longitudinally; the interior is starchy and white; the cortex on section is seen to be hard and gritty and of a yellowish colour; taste slightly acrid; the central starchy portion is almost tasteless. The odour of the freshly cut tuber is faintly acrid.

Chemical composition.—Wiggers obtained from the fresh root a distillate having the odour of bitter almonds, and acquiring a blood-red colour by ferric chloride; separated by means of ether the volatile oil had a pale yellow colour; the analysis of the fresh root by Morin proved the presence of starch, sugar, fat, malates, oxalates and phosphates, a little tannin, &c. (Stillé and Maisch, *National Dispensatory*, 3rd Ed., p. 1122.)

Commerce.—The tubers are imported from Turkey.

COPTIS TEETA, *Wall.*

Fig.—*Griff. Ic. iv., t.* 660, *f.* 2.

Hab.—Assam, China, Tibet. The rhizome.

Vernacular.—Mámírán, Mishmí títa (*Hind., Bomb.*), Haladiovachnag (*Guz.*), Sou-line or Chynlen (*Chin.*).

History, Uses, &c.—The μαμιρὰς of Paulus Ægineta, who doubtless obtained his knowledge of it from the early Indian traders; the drug probably passed by the same commercial route as it does now, viz., from China to Western India, and thence to Europe. Mámírán is noticed by the early Arabian writers as a kind of Turmeric (Urúk). The plant is described by Mir Muhammad Hussain "as having leaves like ivy; it is said to grow near water in the hilly parts of India, China, and Khorasán. The Indian kind is described

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as yellow with a brown tinge; the Chinese as yellow; the Khorasán as greenish brown; the seed is said to be like sesamum. The best kind is the Chinese, which should be small, yellow, hard, and knotty; it is said to keep good for twenty years." Whether the three kinds here described are all varieties of Coptis, it is impossible to decide. Indian writers say that Mámírán used as a collyrium clears the sight, and as a snuff the brain, and that it relieves toothache. Internally it is given in jaundice, flatulence, and visceral obstructions. Bernier, who visited Cashmere in the train of the Emperor Aurangzebe, mentions Mámírán as a medicine very good for the eyes, which was brought into that country by caravans from Thibet. It was first described by Wallich in 1836. (*Trans. of Med. and Phys. Soc. of Calcutta*, VIII., 85.) It is worthy of notice that this drug, and extract of Barberry (Rusot), both containing a large quantity of berberine in a soluble condition, are used as collyriums by the natives in certain catarrhal and rheumatic affections of the conjunctiva. (*Cf.* Prof. Simpson in *Phar. Jour.* 1854, Vol. XIII., p. 413.) Lately Coptis root has been chiefly used as a tonic by Europeans in India; it has the advantage of acting gently on the bowels. Extended observation of the action of Coptis root shows, that during recovery from malarial fever and in atonic dyspepsia (the inward fever of the natives) it is a valuable medicine, restoring the appetite and giving tone to the system. It may be administered in infusion (one ounce to a pint of boiling water) or in tincture (one ounce to a pint of rectified spirit) in doses of two drachms of the tincture or two ounces of the infusion; or the two preparations may be combined.

Description.—Two distinct varieties of this drug are met with in the Indian market. The kind most esteemed is a yellowish rhizome, as thick as a crow-quill or larger, having a few spinous projections where rootlets have been broken off; the whole rhizome is jointed, but at the upper end the joints become much more marked, and a stem clasping petiole often remains attached to each. The roots are described by Paulus

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as having many knuckle-like joints—*μαμιρας οἱον ῥιζίον τι πόας ἔχον ὥσπερ κονδύλους πυκνούς.* The second kind is as thick as a goose-quill, and covered with thin wiry rootlets; it often branches at the crown into two or three heads, which terminate in tufts of leaf stalks, crowded together, and not separate as in the first kind; the rhizomes of both kinds are contorted, and have a short fracture, the centre is spongy, and the surrounding portion bright yellow and woody; taste purely bitter. The first kind corresponds with the description of Coptis root in the *Bengal Dispensatory*. The second kind with the description in the Pharmacographia, which appears to refer to *Coptis anemonæfolia*. (*See Pharm. Journ.* (3) X., p. 23.)

Microscopic structure.—The bark of the second kind is much the thickest, and is softer and more corky than that of the first; in both kinds bundles of orange-coloured schlerenchymatous cells are present, and the medullary rays contain starch; the wood is arranged in distinct wedge-shaped bundles, round a central parenchymatous portion, having a structure similar to that of the inner cortex.

Chemical composition.—Coptis root contains 8½ per cent. of berberine so combined as to be easily soluble in water; the nature of this combination has not yet been determined. E. Z. Gross has separated from *Coptis trifoliata, Salisb.*, *coptine*, a colourless alkaloid. Coptine forms with potassio-mercuric iodide a crystalline precipitate which dissolves in Sulphuric Acid to a colourless liquid, becoming purple-red when heated. (*See Atisine.*)

Commerce.—Both kinds of the drug come to Bombay from China, *via* Singapore, in bulk. The first sort is worth Rs. 3¼ per lb.; the second Rs. 2. The first kind is also imported into the plains of India from Assam in small egg-shaped baskets.

THALICTRUM FOLIOLOSUM *DC.*

Fig.—*Royle Ill.*, *t.* 51.

Hab.—Temperate Himalaya, Khasia Hills. The root.

Vernacular.—Pílíjarí, Shuprak (*Hind.*), Gurbiání, Pashmaran (*Punj.*).

History, Uses, &c.—The genus Thalictrum is found in the temperate and cold northern regions of Asia, it is very rare in the South, but one species, *T. Dalzellii*, is found on the mountains of the Western Peninsula. In Europe *T. flavum*, under the names of *Meadow Rue, Rue des près, Fausse rhubarbe, Rhubarbe des pauvres, Unächte rhabarber, Wiescurante* and *Pigamo*, has long been used as a rustic medicine on account of its tonic and aperient properties. *T. foliolosum*, and perhaps another species from Arracan, have been used for a similar purpose in India from an early date. It is, perhaps, the Pitaka of Sanskrit writers. We have been able to identify as Thalictrum root the drug which is occasionally to be seen in the shops under the name of *Piaranga*,* and which is treated of at great length in the Makhzan-el-Adwiya as a root which is brought from Arracan to Sylhet and Islamabad, and thence distributed to other parts of India. The people of Arracan appear to consider it as a panacea. The following information as to the properties of *Pilijarí* is contained in the *Bengal Dispensatory*, where the result of a trial of the root, supplied from the Saharunpore Gardens, is related :—"Five grains of the powder, or two grains of the watery extract given three times a day in some cases prevented, and in others moderated, the accession of fever, and at the same time acted gently on the bowels. The only sensation experienced was warmth at the epigastrium and a general comfortable feeling." (*Beng. Disp.* p. 161.) The Piaranga of the shops in the form of a tincture has been administered to some extent at the European General Hospital, Bombay, and found to be a good bitter tonic. Recently the root of *T. foliolosum* obtained from the Superintendent of the Saharanpore Gardens has been used with very satisfactory results in Bombay as a remedy for atonic dyspepsia accompanied with a febrile condition of the system. (*Dr. Pechey.*)

Description.—Roots long, nearly straight, without rootlets, stout and woody, from ½ inch or more to ¼ inch in diameter

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* Probably the same drug as the Pia-amou-leek of Ainslie.

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Bark smooth, wrinkled longitudinally, yellowish brown; wood hard, very porous, and of a bright yellow colour, when wet it stains the fingers yellow. Magnified, the porous woody stem is seen to be traversed by medullary rays consisting of several rows of elongated cells: the bark shows a brown suber, and numerous rows of tangentially extended cells; opposite the terminations of the medullary rays, the cells take a rounded form and their arrangement becomes irregular; between the terminations of the medullary rays there is a large deposit of yellow colouring matter with thickening of the cell walls, forming yellow columns which extend to the suber and often end in patches of liber cells. The root at first sight might be mistaken for liquorice root; it is extremely bitter.

Chemical composition.—Thalictrum root contains a large quantity of berberine, so combined as to be readily soluble in water.

Commerce.—It occasionally appears in the shops in small quantities as Piaranga root. Supplies can be obtained, if ordered from Mussoorie, through the Superintendent of the Government Gardens.

CLEMATIS TRILOBA, *Heyne.*

Hab.—Mountains of Western India.

Vernacular.—Morwel (*Mar.*).

This plant, and probably another Himalayan species, *C. nepalensis, Dc.*, is mentioned by Sanskrit writers under the name of Laghukarni (light-ear) as a remedy in leprosy, blood diseases, and fevers.* In the Concan the juice of the leaves mixed with that of the leaves of *Holarrhena antidysenterica* is dropped into the eye to cure staphyloma; about two drops are used.

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* The *Clematis vitalba, Linn.* κληματὶς ἑτέρα of Dioscorides was used for similar purposes by the Greeks. The plants of this genus have acrid properties. Braconnot has observed that the active principle may be distilled with water and is soluble in fixed oils.

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Description.—Climbing, all softly silky; leaves small, on longish petioles, simple or ternately divided, elliptic ovate or cordate, 3-nerved. Panicle many flowered; lower bracts leafy, flowers 1½ to 2 inches diam., white, appear in September; sepals 4 to 6, membranous, oblong, silky outside; filaments narrow, linear, glabrous. Many other species of Clematis grow in the temperate Himalaya, but do not appear to be used medicinally.

ACTÆA SPICATA, *Linn., Eng. Bot.* 13, 918.

Baneberry (*Eng.*), Racine de Saint Christophe (*Fr.*).

Grows in the temperate Himalaya from Bhotan to Hazara; it is also a European plant, and a variety with red berries is well known in America. It does not appear to be known as a medicinal plant to the Hindus; its chemical constitution is the same as that of *Cimifuga racemosa.* (*See* next article.) It is probably the Actæa of Pliny, 27, 26.

CIMIFUGA FŒTIDA, *Linn., Lam. Ill.* 487.

Bugbane (*Eng.*), Cimicaire (*Fr.*).

Is a native of the temperate Himalaya from Bhotan to Cashmere; it also occurs in Europe and Siberia. We have no knowledge of its use by the Hindus. In America *C. racemosa, Elliot,* (*Actæa racemosa, Linn.*), Black Cohosh, is used medicinally and is a depressant of the nervous and vascular systems, causing giddiness, nervous tremour, depression of pulse, nausea, and increased pulmonary and cutaneous secretion; in excessive doses it is an irritant emeto-cathartic and often causes violent delirium. The plant affords a crystalline neutral principle slightly soluble in ether and water, freely so in chloroform and alcohol. The latter solution has a pungent acrid taste. *C. fœtida* has not been examined.

The medicinal plants of minor importance belonging to the *Ranunculaceæ* and known in India are the following:—

Anemone obtusiloba, *Don., Royle Ill.* 52, t. 11, f. 1, is a native of the temperate and Alpine Himalaya, the root of

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which, Stewart says, is mixed with milk and given internally for contusions, and used externally as a blister. Persian and Arabian medical writers describe several kinds of Anemone under the name of Shakayak-el-Naaman; they copy closely from the Greeks, with the addition that these plants are used with Walnut husks for dyeing the hair black. (*Cf.* Dios. II., 167; Pliny, 21, 94.)

Caltha palustris, *Linn.*, *Eng. Bot.* 8, 506. The Marsh-marigold is a native of marshes in the western temperate Himalaya. It is a common European plant. The natives of India consider the roots to be poisonous.

Delphinium Brunonianum, *Royle*, *Bot. Mag.* t. 5461.

Vernacular.—Sámp-phali. (*Hind.*) Is a native of the Punjab Himalaya, and is prized for its strong scent of musk. It is offered to idols, and Aitchison says that the juice is used to destroy ticks in animals. (*Journ. Linn. Soc.*, XVIII., p. 25.)

Delphinium cœruleum, *Jacq.*, *Voy. Bot.* 7, t. 6.

Vernacular.—Dakhangú. Is a Punjab plant, the root of which is used to kill maggots.

Delphinium denudatum, *Wall.* Is also a Punjab plant. Stewart says the root is chewed to cure toothache.

Peonia emodi, *Wall.*, *Bot. Mag.* 5719. Is the *Mamekh* of the Punjab and a native of the temperate Himalaya. It is said by Watt to be used in the same way as *P. officinalis*, *Linn.*

Ranunculus sceleratus, *Linn.*, *Eng. Bot.* 10, 681.

Vernacular.—Kabikaj (*Pers.*). Is a native of Northern India. It is one of the plants known as Batrachion to the Greeks, which Galen says should not be used on account of their acrid properties. The Romans called these plants *Ranunculus.* Fée and Hardouin consider it to be the same as the *Apiastrum* of Pliny and identify it with the *Ranunculus Sardous* of Croatz, the plant which produces a contraction of the mouth, famous

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as the "Sardonic grin." It is called in English, Water Crowfoot and Celery-leaved Crowfoot, and in Arabics, Kaf-es-saba. (*Cf.* Dios. II., 166; Pliny 25, 109.)

Remarks.—Galen tells us that the Anemones are emmenagogue and galactagogue, and have acrid, drawing, cleansing and opening properties; when chewed they increase the secretion of saliva. The juice cleanses the brain when administered by the nostrils, and lessens or removes opacities of the cornea; it cleanses ulcers and cures scaly skin diseases if applied locally, &c. In Europe the drug appears to have fallen into disuse until about the end of the eighteenth century, when Störk again brought it to notice, and latterly in America several species of Anemone, under the name of Pulsatilla and their active principle anemonin, have been rather extravagantly praised as remedies for a long list of diseases. When pure anemonin is given to rabbits in doses of from 5 to 10 grains, it reduces the pulse, and respiration rate and the temperature; causes dyspnœa and stertor, debility, and then paralysis of the limbs, stupor, dilatation followed by contraction of the pupil, and death without convulsions. On dissection, the heart and great vessels and the veins of the brain and medulla are found distended with dark blood. (*Clarius.*) Externally it acts as an irritant to the skin. The extract and tincture of the plant differ from pure anemonin, inasmuch as large doses cause inflammation of the stomach and bowels and death with convulsions. The cause of this difference has not been ascertained. Applied to the tongue, both the drug and anemonin cause a sense of burning followed by numbness. In medicinal doses, (4 to 5 grains of the herb or ⅙ to ½ a grain of anemonin) the drug is now considered to act as a general stimulant and diuretic.

The different species of Anemone and Ranunculus when distilled with water yield a distillate, from which ether extracts a very acrid yellow oil (anemonol) which is gradually, or more rapidly in the presence of water, converted into anemonin and anemonic acid, from which hot alcohol dissolves

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the former. Anemonin forms colourless friable crystals, which are neutral, inodorous, and when fused exceedingly acrid; it is soluble in chloroform, but nearly insoluble in ether and water. Formula $C^{15} H^{12} O^6$. (*Fehling.*) Anemonic acid $C^{15} H^{14} O^7$ is a white crystalline very insoluble powder, which dissolves alkalis with a yellow colour.

Some species of Delphinium contain the alkaloids delphinine $C^{22} H^{35} NO^6$, and staphisagrine $C^{22} H^{32} NO^5$, the former very closely resembles aconitine in its physiological action and is antidotal to muscarine and digitalin; the latter paralyses the motor nerves like curare. Both of the alkaloids are soluble in alcohol, but delphinine may be separated from staphisagrine by means of ether in which the latter is insoluble.

MAGNOLIACEÆ.

ILLICIUM VERUM, *Hook. f.*

Fig.—*Bot. Mag. t.* 7005. *Star-anise tree* (*Eng.*), *Badianier* (*Fr.*).

Hab.—Cochin-China. The fruit.

Vernacular.—Bádián-i-khatai (*Pers.*), Anasphal (*Hind.*), Anna shuppu (*Tam.*), Bádián (*Bomb.*), Anása-puvvu (*Tel.*).

History, Uses, &c.—It would appear that star-anise has long been in use in China and Japan, but was not known in India until a comparatively recent date. Persian works on Materia Medica, written about one hundred years ago, speak of it as a new medicine. The authors of the Pharmacographia trace its introduction into Europe as far back as 1588; in those days it came by way of Russia, and was known as Cardamomum Siberiense. Mr. J. G. Scott, in a paper read before the Royal Geographical Society, describing Cua-ai, where the Chinese and French

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Commissioners met for the delimitation of Tongking, says: "Maize, white and red rice, and the star-anise seem to be what the people chiefly cultivate upon the hill slopes. The star-anise is an evergreen shrub, with a leaf not unlike the Bay, and a pentagonal fruit very highly scented. From this is obtained the oil called by the Tonkinese *Dau hoi* (scented oil) and by the French *Huile de badiane.* The Chinamen boil the fruit in a huge caldron with water, inside this caldron there is a small internal vessel filled with cold water, which is constantly renewed. The steam and oil are condensed on the sides of this vessel, and are drawn off by a small bamboo runlet into the receiver; another runlet allows the water from this pan to drain back into the boiler. One boiling lasts over a day and a half, and produces about 15 pounds of oil. A picul, 117 lbs. weight, of the oil costs between £30 and £40. At present the greater part of the star-anise oil goes into China."

In Native medicine star-anise is considered to be hot and dry in the second degree; and is described as carminative, expectorant, and diuretic; it is often given in infusion with tea, and is also mixed with food as a spice. In European medicine it is described as an aromatic, stimulant and carminative. It is a favourite adjunct to cough mixtures, and on account of its sweet taste is specially suitable as a carminative for children.

Description.—For a very complete description of the commercial article, see *Pharmacographia*, p. 21. An Indian species, *I. Griffithii*, occasionally finds its way into the market; it has narrower and more numerous carpels, one or two only in each fruit are fertile; a handful of fruit upon examination proved to be all provided with 13 carpels; they are of a dark reddish brown colour, much wrinkled on the under surface; the seeds correspond with those of *I. verum*; the taste is feebly aromatic at first, afterwards bitter and astringent. The oil of Star-anise is free from the peculiar fatty smell of aniseed oil. (*Umney.*)

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Microscopic structure.—The fruit of *I. Griffithii* has the same structure as that of *I. verum*, but in the external loose dark brown layer of cells, hardly any globules of essential oil can be seen; on making sections for the microscope the knife is immediately stained black by tannin, which is not the case with *I. verum*; for a microscopic description of the latter article consult the *Pharmacographia*, p. 21. Wood-cuts of the fruits of *I. verum*, *I. religiosum* and *I. Griffithii* may be found in a paper by Mr. E. M. Holmes in the *Pharm. Journ.*, 3rd Series, XI., 489.

Chemical composition—Star-anise contains from 4 to 5 per cent. of volatile oil, which is chiefly solid and liquid anethol, like that of *Pimpinella Anisum.* The specific gravity is 0·978, molecular rotation 0° to 0·4, with the chloral reagent * it affords eventually a red colour like Ol. Fœniculi. Its other reactions are similar to those obtained with aniseed oil. Star-anise contains much sugar, probably cane. (*Eijkman.*) Umney has pointed out that the congealing point of the oil when at rest is about 35° F., whereas that of aniseed oil is about 50°. When stirred, the congealing point of both oils is from 50° to 60° F.

The fruit of *I. Griffithii* would appear to contain some bitter principle as well as tannin. According to J. F. Eijkman, the fruit of *I. religiosum*, which has poisonous properties, contains proto-catechuic acid, shikiminic acid and shikimipicrin. The latter would appear to be the poisonous principle; it forms large transparent crystals, melting at 200° C., which are freely soluble in water, forming a neutral solution with a very bitter taste. The formula is $C^7 H^{10} O^5$ or $C^{10} H^{14} O^4$. In the volatile oil of the leaves he discovered eugenol, shikimen and shikimol; the second is, he thinks, a terpine, and the last identical with safrol. (*Rec. Trav. Chim.* IV., 32—54, *Year-Book of Pharm.*, 1885, p. 171.)

Commerce.—Star-anise is shipped to India from China in large quantities, and two qualities are met with, selected in boxes worth Rs. 17 per Surat maund of 37½ lbs., and broken in bags, value Rs. 14 per maund. The oil which comes from China in 12 catty tin jars sells for about Rs. 4½ per catty.

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* Alcohol saturated with H Cl.

MICHELIA CHAMPACA, *Linn. var. Rheedii.*

Fig.—*Wight Ill. i., t. 5, f.* 6. Golden or Yellow Champa (*Eng.*), Champac (*Fr.*).

Hab.—Temperate Himalaya, from Nipal eastward; Pegu, Tenasserim, Nilgiris and Travancore. Commonly cultivated. The bark.

Vernacular.—Champa (*Hind., Beng.*), Shampang (*Tam.*), Pivalá-cháphá (*Mar.*), Ráe champo (*Guz.*), Sampangi-puvvu (*Tel.*), Sampage-huvvu (*Can.*).

History, Uses, &c.—There appear to be several varieties of Michelia which have been produced by cultivation. *M. Rheedii*, which is referred by Hooker and Thomson to *M. Champaca*, is cultivated in India for the sake of its yellow, sweet-scented tulip-like flowers, which are made into a wreath (*veni*) and worn by women at the back of the head. The Champa, in Sanskrit Champaka or Dipapushpa (lamp flower) appears to have been cultivated in India from a very early date; it has many synonyms expressing praise of its delicate form, golden colour and intoxicating perfume.

The bark is mentioned in the secondary list of the Pharmacopœia of India as having febrifuge properties; but the natives of India do not generally use it, nor is it to be met with in the shops. According to Rheede and Rumphius the flowers are diuretic and are used in gonorrhœa to relieve scalding, pounded with cocoanut-oil they are applied as a plaster to inflamed parts. The root is said to be emmenagogue, and the oil of the seeds is rubbed into the abdomen to relieve flatulence.

Description.—The fresh bark is covered externally by a light brown epidermis, which can be easily removed by friction; beneath this, it is of a reddish brown colour mottled with longitudinal green stripes, and pale yellow scars of irregular form; the inner surface is yellowish and fibrous, taste feebly bitter, with a faint aroma. It contains tannic and gallic acids.

Microscopic structure.—It is chiefly remarkable for aggregations of large stony cells of a bright yellow colour. The parenchyme contains much starch.

MICHELIA NILAGIRICA, *Zenker.*

Fig.—*Zenker Plant. Ind. t.* 20. Hill Champa (*Eng.*).

Hab.—Higher mountains of the Western Peninsula and Ceylon. The bark.

Vernacular.—Shempangan, Sempagum (*Tam.*), Sapu (*Cing.*).

History, Uses, &c.—This tree, like the Champa, yields a valuable timber. The bark is said to have been made into decoctions and infusions and used as a febrifuge, but there is no evidence of its being used for that purpose at the present time.

Description.—The stem bark is covered with a light brown, corky layer, which scales off or may easily be removed when dry; it is brittle, and its irregularly broken surface is frequently beset with lichens and mosses. Between the cork and intermediate layer are pinkish masses of various forms. The surface of the middle layer is pale brown; in the fresh state it is marked with longitudinal green stripes; it is hard and dense, and very much resembles the bone at the base of horns. A fracture shows that the middle layer is dense and of a reddish colour, and the inner layer dirty yellowish-brown, tough, and of fibrous consistence. The inner surface is russet-brown, and striated with the fine longitudinal marks of the white liber tissue. A transverse section touched with a drop of ferric chloride solution shows that tannin is present in the two inner layers only. The bark affords a light cinnamon-brown powder, slightly bitter in taste, with a faint terebin-

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thmate odour. The bark of the branches and younger stems is uniformly pale brown, less bitter, and more aromatic.

Chemical composition.—The powdered bark gave 10·6 per cent. of moisture, and left 9·7 per cent. of ash. It contained a volatile and a fixed oil, acrid resins, tannin, giving a greenish-black colour with ferric salts, sugar, a bitter principle, mucilage, starch, calcium oxalate, &c. Search was made for alkaloids and mannite with negative results. A decoction did not give the usual blue colour with iodine until a considerable quantity of the reagent had been added, a reaction peculiar to cinnamon and cassia barks.

Commerce.—The oil of *Michelia nilagirica* which was stated (*Pharm. Journ. Oct.* 22, 1887, p. 344,) to be obtained from this bark, was in reality distilled from the bark of *Cinnamomum Wightii,* a tree found on the hills of Southern India.

ANONACEÆ.

ANONA SQUAMOSA, *Linn.*

Fig.—*Rheede, Hort. Mal. iii.,* 29; *Bot. Mag.* 3095; *Gartn. Fruct. ii., t.* 138. The Custard Apple tree (*Eng.*), Cachiman (*Fr.*).

Hab.—Tropical America, cultivated in India. The seeds, leaves and bark.

Vernacular.—Sitáphal (*Hind., Mar.*), Sita-pullum (*Tam.*), Ata, Lúna (*Beng.*), Sita-pundu (*Tel.*), Atta (*Cing.*).

History, Uses, &c.—The custard-apple has been long naturalized in India, and has received the Sanskrit name of Gandhagátra. The seeds, leaves, and immature fruit, contain an acrid principle which is destructive to insect life; the seeds are much used by the natives for removing lice from the head;

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they require to be applied with caution; for if any particles get into the eye, much pain and redness is produced. The author of the Makhzan notices the poisonous action of the seed upon lice, and says that when applied to the os uteri, they cause abortion. The fruit is called Sharifah and Káj in Persian. Rheede states that the ripe fruit mixed with salt is used as a maturant. The root is considered to be a drastic purgative, and is administered by the natives in atrabilis or melancholia, much as Hellabore was by the Greeks. In the Antilles, Guiana and Reunion the leaves are employed to make a sudorific infusion (thé Corrossol), and in India the crushed leaves are applied to the nostrils of women suffering from hysterical or fainting fits.* The leaves are also used to destroy maggots in sores, and to assist in removing the Guinea-worm.

Description—Seed dark brown, polished, with two lateral ridges, tapering towards the umbilical end, where there is a prominent ring, with a central pit, length about five-eighths of an inch, breadth two-eighths, albumen large, ruminated, embryo minute. Leaves oblong, obtuse or acuminate, glaucous beneath, 2—3 by $\frac{3}{4}$—$\frac{1}{2}$ inch, pubescent when young, when dried black, odour when crushed pungent and offensive.

The fruit is globose or ovoid, light green, tuberculous, the size of a large apple, and is composed of the numerous, confluent, ripe carpels, each of which contains one large seed, pulp sweet, of a delicate spicy flavour, easily digested.

Microscopic structure.—The testa of the seeds is composed of two sets of yellow rod-like cells, with a narrow central cavity, the outer set are arranged vertically but the inner project into the albumen and divide it into numerous small bundles. The albumen consists of large polyhedral cells filled with starch.

Chemical composition.—The seeds yield an oil and resins; the latter appear to be the acrid principles.

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* Rheede notices the use of the unripe fruit in a similar manner in vertigo.

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The bark has been examined by Pedler and Warden, who found indications of an alkaloidal principle, but failed to isolate it in a pure state; they also found an acid resin insoluble in ether, and two resins soluble in ether; as well as a white crystalline principle soluble in alcohol and ether, but insoluble in water or dilute acids, and a viscid yellow neutral resin-like body.

BOCAGEA DALZELLII, *H. f. & T.*

Hab.—Forests of the Concan and Travancore. The leaves.

Vernacular.—Sájeri, Kochrik, Hárkinjal (*Mar.*).

Description.—Leaves polished, narrow-oblong, acute or obtuse, 5—9 inches long by 1—2 broad, coriaceous, serrated, base acute or rounded; flowers white; carpels globose, smooth, about one inch in diameter, usually containing two mature seeds. Graham, under the name of *Guatteria laurifolia*, describes this tree as like the Portugal laurel, and says that it flowers in November, and bears fruits the size of a marble, which when cut open have an agreeable smell like the wild English Angelica. In the Concan, the leaves are used as a fomentation in rheumatism by the natives; they have a pungent, astringent and bitterish taste. The tree yields a valuable reddish timber which is used in house building.

Chemical composition.—The leaves contain tannin, giving a blue-black precipitate with ferric salts, and a very small quantity of gallic acid. The aqueous extract contains a ferment which produces a pungent alliaceous odour as soon as an infusion is made of the leaves. It is precipitated from its aqueous solution by alcohol, and is to some extent dissolved again by heat. The distillate is oily, with a pungent odour and taste, and neutral in reaction. The leaves also contain a crystalline body extracted by boiling alcohol from the marc left by ether and cold alcohol exhaustion; it is probably the body related to sinigrin of mustard seed, which gives the pungent property in contact with water. The leaves yield 7·8 per cent. of ash.

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MENISPERMACEÆ.

JATEORHIZA CALUMBA, *Miers.*

Fig.—*Bentl. and Trim.*, *t.* 13. Calumba (*Eng.*), Colombo (*Fr.*).

Hab.—Oibo, Mozambique. The root.

Vernacular.—Kalamb-kí-jer (*Hind.*), Kalamb kachri (*Bomb.*), Kalamba ver (*Tam.*), Kálamba-veru (*Tel.*).

History, Uses, &c.—Calumba grows in the forests of East Africa, along the Mozambique Coast, in the Zambesi country, and Madagascar; the Arabs call it Sák-el-hamám, 'dove's foot,' from the resemblance of the hairy ovaries with their three-parted stigmas to the leg and foot of a dove. The drug appears to have been first introduced into India by the Portuguese. In Africa it would seem to have been long used as a medicine in dysentery, and other affections of the bowels. Flückiger and Hanbury's researches have traced its introduction into Europe to the Portuguese, as far back as 1671. Shortly after this date, Francisco Redi noticed it as an alexipharmic. It would then appear to have been neglected until re-introduced by Percival in 1773; since then it has been in constant use in Europe as a mild tonic. The older English physicians in India probably became acquainted with it through the Portuguese The plant was introduced into Madras in 1805, and subsequently into Bengal and Bombay, but it appears now to have died out. Calumbin, the non-nitrogenous crystalline bitter principle occurring in Calumba-root together with berberine is usually represented as not possessing much physiological activity. Dr. Lander Brunton says (*Pharmacology*, p. 757), it seems to have less action than berberine. But some experiments made with the separated crystalline principle, and reported by M. Houdé (*Repértoire, March*, 1886, p. 113), point to it being a somewhat energetic substance, giving rise to vomiting and diarrhœa. In small doses it appeared to augment the secretion of bile, of the glands

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of the stomach, and the intestine; after full doses the liver appeared to undergo granular fatty degeneration. A dose of 10 centigrams administered to fowls caused death, preceded by digestive disturbance and frequent evacuation. It is thought that if it were not that calumbin is present in Calumba in only small amount (0·35 to 0·4 per cent.) it would prove an inconvenient constituent in the administration of the drug. (*Pharm. Journ.*, 1886.) Calumba appears to owe its tonic action chiefly to berberine (*see* Berberis); it also possesses the advantage of containing no tannin, and consequently does not form an inky mixture with salts of iron. It is used in atonic dyspepsia and debility of the digestive organs, and appears to increase the secretion of bile. Trousseau and Pidoux recommend it especially when there is subacute inflammation of the gastric mucous membranes, with a bitter taste in the mouth, heat and pain at the epigastrium, nausea, slight fever and perhaps diarrhœa.

The powdered root has been used for dressing unhealthy sores.

Description.—The drug consists of nearly round or oval transverse slices of the root, varying much in size; these, when freshly imported, are of a light, bright greenish yellow colour, and have their edges covered by a wrinkled, corky epidermis; the surface of the slice shows a central portion, often much contracted in the middle, the vascular bundles standing out as rough projections, and a cortical portion from two to three-eighths of an inch thick. Calumba is light and breaks easily with a short starchy fracture, the odour is mossy, and the taste very bitter.

Microscopic structure.—Commencing externally we find a range of tabular cells forming the suber; within this, a broken line of thick-walled yellow cells; and next a cellular parenchyme loaded with starch and yellow colouring matter, making up the bulk of the bark, and intersected by radiating bands of liber tissue. The central portion of the root consists of a starchy parenchyme, intersected by radiating bands, formed

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of bundles of large vessels, which are more or less surrounded by a layer of wood cells. The starch granules are very large and ovoid.

Chemical composition.—The root contains calumbin, berberine and calumbic acid. Calumbin may be obtained by treating the root with alcohol of 75 per cent.; the alcohol is recovered, and the residue, after evaporation, dissolved in water, and shaken with ether, which takes up fatty matters and the calumbin; the latter is purified by crystallization from boiling absolute ether; it forms right rhombic prisms, and is neutral and very bitter. Calumbic acid was obtained by Baedecker by adding hydrochloric acid to the product obtained by the treatment of an alcoholic extract of calumba by lime water; it forms strongly acid white crystalline flakes. Both calumbin and calumbic acid are very sparingly soluble in cold water or cold alcohol, and ether. (*Dict. de Chimie; Wurtz.*, Vol. 1, p. 959.) Baedecker has pointed out a connection between these three bitter principles.

If we suppose a molecule of ammonia NH^3 to be added to calumbin $C^{42} H^{44} O^{14}$, the complex molecule thence resulting will contain the elements of berberine $C^{20} H^{17} NO^4$, calumbic acid $C^{32} H^{24} O^7$, and water $3 H^2O$ (*Pharmacographia*, p. 25). Duquesnel has recently published the following process for obtaining calumbin. Exhaust the powdered root with 95 per cent. alcohol, recover the alcohol, treat the syrupy residue with chloroform. Filter the chloroform solution and evaporate; treat the residue with 60 per cent. alcohol which dissolves most of the colouring matter. The residue, which contains the calumbin, is dissolved in strong alcohol, decolorised with animal charcoal and crystallized. The yield should be 0·35 to 0·4 per cent.

Commerce.—Calumba root is imported into Bombay from the Mozambique Coast to the extent of from 200 to 400 bales annually.

The bales are of matting, and contain about one cwt. each, value Rs. 3½ per Surat maund of 37½ lbs.

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ANAMIRTA COCCULUS, *W. & A.*

Fig.—*Rheede, Hort. Mal. vii., t.* 1; *Bentl. and Trim. t.* 14. Cocculus Indicus (*Eng.*), Coque du Levant (*Fr.*).

Hab.—Concan, Malabar, Eastern Archipelago, Eastern Bengal, Assam. The fruit.

Vernacular.—Kakámari (*Hind., Can., Tel., Beng.*), Kákphal (*Guz.*), Karwi (*Mar.*), Kákkáy-kolli-virai (*Tam.*), Heuber, Netrmala (*Punjab*)

History, Uses, &c.—This plant, which is a large climbing shrub with rough corky bark, is probably the Kákaphala of Sanskrit writers; its properties must have been known to the Hindus from an early date, and the fruit appears to have been long in use as a remedy in certain skin affections, possibly of parasitic origin. The Arabs were probably also acquainted with it, but there is no satisfactory evidence upon this point to be gathered from their writers upon Materia Medica. Sprengel would make it the Mahír-harj of Ibn Sina, but this is evidently incorrect; as Ibn Sina describes that plant as "like *Shibram* (Tithymalus), which some people class among the milky shrubs." According to Flückiger and Hanbury, Ruellius was the first European writer who mentioned it (*De Natura Stirpium, Paris,* 1536), under the name of Cocci orientis. Gerarde calls it Cocculus Indicus; it also bore the name of Coccole di Levante (Levant berries), from its being introduced into Europe through the Levant ports. In the Concan the juice of the leaves with that of the root of *Gloriosa superba* is used to kill Guinea-worms. Rumphius, vii., 18, notices its use to kill fish, and also birds of Paradise, by poisoning the holes full of rain water in the trees they frequent. He says that in Ceylon and Malabar they catch wild cattle, &c., by poisoning Jack fruits with it, and placing them in the woods.

Picrotoxin, the active principle of the seeds, has been found useful in the night sweats of phthisis in doses of $\frac{1}{120}$ to $\frac{1}{60}$ of a grain; it is also employed to destroy pediculi in the form of

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an ointment (10 grs. to 1 oz.), and is official in the United States Pharmacopœia.

When administered internally it stimulates all the motor and inhibitory centres in the medulla, especially the respiratory and vagus centres. It also irritates motor centres, either in the cerebrum or in the medulla and cord, producing in all vertebrates alternating epileptiform spasms, with periodic stoppage of the motions of the diaphragm and slowness of the pulse. The spasms often take the form of swimming, running backwards or round in a circle (manège movements), or rolling of the body on its axis. The temperature is somewhat raised. (*Lauder Brunton.*) Some preliminary experiments made by Professor Arpad Bokai go far to show that picrotoxin is probably the best antidote for morphia poisoning. It is said to prevent paralysis of the centre of respiration, by which death from morphia is caused. It has also exactly the opposite effects of morphia on the pressure of the blood.

Description.—A somewhat reniform purple fruit, the size of a small grape, growing in a long bunch, each branch of which supports from 1 to 3 of the drupes. The dry fruit is about the size of a large pea, dark brown, and wrinkled; below the concavity on one side there is a circular scar, to which a portion of the peduncle sometimes remains attached; above it is a small pointed projection, the remains of the style; within the dried pulp is a thin shell, which at the concave part of the fruit dips in deeply to form a placenta, which projects in the shape of two lobes into its cavity, upon these the kernel is moulded, and has consequently a cup-shaped form, the cavity of the cup being marked by a longitudinal ridge, corresponding to the fissure between the two lobes of the placenta. The kernel consists of two layers of albumen, which, when separated, disclose a superior radicle, from which two thin cotyledons diverge, narrow at first, but afterwards widening. Cocculus Indicus is very bitter, and if kept long has a rancid oily smell.

Microscopic structure.—The albumen is composed of polyhedral cells containing crystals of fatty matter.

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Chemical composition.—The pericarp is said to be emetic, and to contain two crystallizable tasteless substances, menispermine and paramenispermine, but this is doubtful, and requires confirmation. Picrotoxin, a crystalline substance, was discovered in the seed by Boullay in 1812; it is the poisonous principle, and is soluble in water and alkalis. Flückiger and Hanbury give the following summary of its properties:—"Picrotoxin does not neutralize acids, it dissolves in water and in alkalies; the solution in the latter reduces cupric oxide like the sugars, but to a much smaller extent than glucose. The alkaline solution is not precipitated by chloride of ammonium. The aqueous solution is not altered by any metallic salt, or by tannin, iodic acid, iodohydrargyrate or bichromate of potassium; in fact, by none of the re-agents which affect the alkaloids. It may thus be easily distinguished from the bitter poisonous alkaloids, although in its behaviour with concentrated sulphuric acid and bichromate of potassium, it somewhat resembles strychnine as shown in 1867 by Köhler. Picrotoxin melts at 200° C.; its composition $C^9 H^{10} O^4$, as ascertained in 1877 by Paternò and Oglialoro, is the same as that of evernic, hydrocoffeïc, umbellic and veratric acids." (*Pharmacographia*, p. 32)

By fractional distillation from Benzol, Barth and Kretschy (1880) separated picrotoxin into three bodies. One, for which the name picrotoxin was retained, melts at 201° C., and has the composition $C^{15} H^{16} O^6 + H^2 O$. The second, *picrotin*, $C^{25} H^{30} O^{12}$, has similar properties, but melts at at 250° C., is less freely soluble in benzol, and is not poisonous. The third compound, *anamirtin*, $C^{19} H^{24} O^{10}$, remains in the mother liquor on re-crystallizing pricrotoxin from water; it is but slightly bitter, is not poisonous, and its alkaline solutions do not reduce metallic salts. Warnecke has obtained from the fruit 5·20 per cent. of ash.

Toxicology.—This drug is occasionally used in Madras and Bombay as a cattle poison. During the last ten years four cases have been reported. In Bombay one case has been reported in which it was used to facilitate the commission of theft. The symptoms are stomach ache, nausea, vomiting, tetanic convulsion, insensibility and sometimes delirium. Dr. Burton Brown notices its use as a poison in the Punjab.

Commerce.—Cocculus Indicus is brought to the Western ports in large quantities for exportation to Europe; it is hardly ever used in India, and is seldom to be seen in the druggists' shops. Value, Rs. 3 per Surat maund of 37½ lbs.

CISSAMPELOS PAREIRA, *Linn.*

Fig.—*Bentl. and Trim., t.* 15.

Hab.—Tropical and sub-tropical India. Cosmopolitan in warm regions. The root.

Vernacular.—Dakhnirbishí, Pahári, Hárjori (*Hind.*), Pahármúl (*Mar.*), Páta (*Tel.*), Tikri, Katorí (*Sind, Panjab*), Karandhis (*Guz.*), Ponmútootai (*Tam.*).

History, Uses, &c.—The plant appears to have been long in use as a bitter tonic and diuretic in Northern and Southern India, and is mentioned by Ainslie. Chakradatta recommends it in fever with diarrhœa and in internal inflammations; it is combined in native practice with bitters and aromatics. In Europe it has never been an article of commerce, though for a long time it was supposed to produce the Pareira root of the shops (*confer. Pharmacographia, p.* 25). The Sanskrit names are Ambáshta, Páthá and Venívela (braided creeper), Pahadamula and Álanádi. In the Punjab and Sind the leaves and roots are employed in the cure of ulcers and in Pudukota for dysentery. The drug is not used in Europe; it appears to act as a mild tonic and diuretic. It is reputed to be antilithic.

Description.—The root is about half an inch in diameter, bark light brown marked with longitudinal furrows, and transverse constrictions, sometimes very crooked and knotty, from

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growing in stony ground, seldom branched, fracture fibrous, bark corky, and thick for the size of the root, wood yellowish, in from 10 to 15 wedge-shaped bundles, containing many large vessels, and separated by narrow medullary rays; odour none; taste very bitter.

Microscopic structure—It cannot be distinguished from several other Menispermaceous roots common in India.

Chemical composition.—The pelosine or cissampeline of Wiggers, which Flückiger has found to be identical with bebeerine, exists in this root to the extent of about ½ per cent. (*Flückiger.*) Pelosine is amorphous, nearly insoluble in water, somewhat soluble in ether and carbon bisulphide, freely soluble in chlorofrom and acetone, also in alcohol and benzol; its nitrate is sparingly soluble, and its acetate is precipitated by sodium phosphate, by the group re-agents for alkaloids, and by iodide, ferrocyanide, ferridcyanide, and chromate of potassium; the precipitate with phosphomolybdic acid dissolves in ammonia with a blue colour. The formula of bebeerine is $C^{19} H^{2} NO^{3}$.

Stephania hernandifolia, *Wall.*; *Wight Ic. t.* 939, extending from Nipal to Chittagong, Singapore and Ceylon, has similar properties, and is known by the same native names as *Cissampelos Pareira*. It is the Ágnád (Ákanádi) of Bengal, where the striated stems are sold in the bazars; but it seems probable that the true Sanskrit name of this plant is Vanatiktika.

TINOSPORA CORDIFOLIA, *Miers.*

Fig.—*Rheede, Hort. Mal. vii.*, 21; *Bentl. and Trim.*, *t.* 12.

Hab.—Tropical India. The stem.

Vernacular.—Gurach, Giloe, Gulancha (*Hind.*, *Beng.*), Gulwail, Guloe, Gharol (*Mar.*), Típpa-tíge (*Tel.*), Shindíl-kodi (*Tam.*), Amrita-balli (*Can.*), Rassakinda (*Cing.*), Gurjo (*Sikkim*), Amritwel (*Goa.*), Gado (*Guz.*).

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History, Uses, &c.—A well-known medicinal plant, long in use in Hindu medicine, and called in Sanskrit Guduchi, Pittaghni (bile-destroying), Bhishakpriya (dear to physicians), Nirjara (not perishing), &c. It is considered to be cold and dry, or according to Arabic and Persian writers, hot and dry in the first degree. In native practice it is much valued as an antiperiodic in fevers, and as a tonic and alterative; it is also credited with aphrodisiac properties.* The fresh plant is said to be more efficient than the dry; it is taken with milk in rheumatism, acidity of the urine and dyspepsia. The juice with Pakhanbed and honey is given in Gonorrhœa, and is an ingredient in Paushtiks given in *Phthisis*. In Guzerat, a necklace called Kamalá-ni-málá (jaundice necklace) is made of small pieces of the stem, and is supposed to cure that disease. The stem, if placed upon a bush in the open air, will retain its vitality through the hot season, and when the rains commence, put forth leaves and long whipcord-like roots, which soon reach the ground, whence the Sanskrit synonym Chinnaruha, or, growing when cut. The plant is very common in many parts of India, and may always be obtained in the green state. Elephants are very fond of the stems, and the hill tribes in Sikkim give it to their cattle to cure pains in the stomach. The dry stem is to be seen in every drug shop; from it is prepared a kind of starch known in Hindustani as Giloe-ka-sat, and in some parts of India as Palo. It is prepared by powdering the stem and washing out the starch with water: the latter retains a little of the bitterness of the drug. *T. cordifolia* appears first to have attracted the notice of Europeans in India at the early part of the present century, and to have been favourably spoken of by those who have tried it as a tonic, antiperiodic and diuretic, but it has never come into general use in European practice. It is now official in the Pharmacopœia of India, and has lately (1884) been re-introduced to the notice of the profession in Europe as a specific tonic, antiperiodic and diuretic. (*Zeitschrift des Oesterr. Apoth. Ver.*, 1884, 312.)

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* For original Sanskrit prescriptions, see Dutt's Hindu Materia Medica, p. 105; most of them contain several other equally active remedies.

Description.—The fresh stem has a green succulent bark, covered by a thin brown epidermis, which peels off in flakes; it is studded with warty prominences, and here and there gives off roots and branches bearing smooth heart-shaped leaves, and bunches of red berries; when dry it shrinks very much, and the bark separates from the wood, and becomes of a dull brown colour; the latter consists of a number of wedge-shaped bundles; the taste is very bitter; the odour not in any way peculiar.

Microscopic structure.—The suber consists of tabular cells, and thick-walled yellow cells, in alternate layers; the woody portion is not to be distinguished from that of several other Menispermaceous plants common in India.

Chemical composition.—The extract called Palo and Sat-i-giloe is simply starch, which, through not having been washed, retains some bitterness, that sold in the bazaars is usually nothing but common starch. The stem has been examined by Flückiger (1884) by boiling it with alcohol and a little hydrate of calcium, the alcohol was then evaporated and the residue extracted by means of chloroform. The latter liquid was found to contain an alkaloid in very small quantity; on evaporating it and dissolving the residue by means of acidulated water, a solution was obtained, which proved to contain merely a trace of berberine. The alcoholic extract after it had been exhausted by chloroform as above stated, was dissolved in boiling water and precipitated by tannic acid, avoiding an excess of the acid. The deposit thus obtained was mixed with carbonate of lead, dried and exhausted with alcohol, which on evaporation yielded the bitter principle. By boiling this bitter principle with dilute sulphuric acid, sugar was produced and it lost its bitterness. Neither the original bitter principle or the product derived from it could be crystallized.

Commerce.—The stems are collected and dried by the country people who bring them for sale to the towns. Value, Rs. 2½ per Surat maund of 37½ lbs.

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COCCULUS VILLOSUS, *DC.*

Fig.—*Pluk. Am., t.* 384, *f.* 3, 7.

Hab.—Tropical and subtropical India. The roots and leaves.

Vernacular.—Jamti-ki-bel, Farid-buti (*Hind.*), Vasanvel, Tána (*Màr.*), Dagadi (*Can.*), Chipuru-tige, Katle-tige (*Tel.*), Haér (*Beng.*), Káttuk-kodi (*Tam.*), Pátála-galori (*Guz.*).

History, Uses, &c.—A very widely-distributed plant of climbing habit, very common everywhere; it has no doubt been long in use as a domestic remedy in all parts of the country, but few of the native works on Materia Medica notice it. The Sanskrit names are Pátála-gárudi, Vásadani and Vásana-valli, "giving a fragrant perfume." It is a disputed point whether this plant or the *Pedalium murex* is the true Faríd-búti upon which Sheik Faríd is reputed to have sustained life for some time. The juice of its leaves mixed with water has the property of coagulating into a green jelly-like substance, which is applied externally by the country people under various circumstances on account of its cooling nature, and is also taken internally sweetened with sugar as a cure for Gonorrhœa. Pliny (24, 99) mentions two plants, Coracesta and Callicia, which, according to Pythagoras, were used by the Magi to congeal water. The root is said to be alterative, and to be a good substitute for Sarsaparilla. Roxburgh says that a decoction of it in goat's milk flavoured with long pepper is administered in rheumatic and old venereal pains, and is considered heating, laxative and sudorific. (*Fl. Ind.* III., 815.) The juice of the ripe berries makes a durable, bluish-purple ink. (*Brandis.*) In the Concan the roots rubbed with Bonduc nuts in water are administered as a cure for belly-ache in children, and in bilious dyspepsia they are given in 6 massa doses with ginger and sugar; they are also an ingredient with a number of bitters and aromatics in a compound pill which is prescribed in fever.

Description.—Leaves 2 to 3 by 1½ to 2 inches, sometimes sublanceolate, retuse or obtuse, and mucronate; sometimes

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three-lobed, base subcordate or truncate, when young villous on both surfaces; petiole ½ inch long. Root very crooked and twisted upon itself, keeled, seldom branched, but giving off a few thin fibrous rootlets; external surface light brown, nearly smooth, transverse section pale yellow, marked with radiating darker yellow lines; odour peculiar, acrid; taste disagreeable and bitter.

Chemical composition.—The air-dried stems and roots were well bruised in a mortar and extracted with rectified spirit in a Thorn's extractor. The resulting tincture was then evaporated at a low temperature on a water bath till free from alcohol. Water was added to the viscid extract, and the turbid mixture, which possessed a strong acid reaction, was repeatedly agitated with ether. During agitation a large amount of dark, soft resinous-looking matter separated and adhered to the bottom of the bottle. The original extract was thus divided into three portions—ethereal solution A, separated resin B, aqueous residue C.

The ethereal solution A, which was of a dark yellowish-brown hue, was agitated with dilute hydrochloric acid; during agitation the aqueous acid solution became turbid from the separation of dark brown flocks. The ether was separated and was of a yellowish colour; it left on spontaneous evaporation a yellowish-green soft resin, which possessed a very fragrant odour, not unlike that of Tolu balsam. Treated with benzol it was partially soluble. No further examination was made of this portion.

The aqueous solution filtered from the brown flocks above mentioned, was of a dark brown colour. The addition of ammonia caused the separation of pinkish flocks, and the solution acquired a reddish hue. The turbid solution was now agitated with chloroform-ether which acquired a pink colour. The separated chloroform-ether left on evaporation a pink residue, non-crystalline, soluble in alcohol, the colour being that of a tincture of Sander's wood. The alcoholic solution did not exhibit any fluorescence, and the colour was the same when viewed by either reflected or transmitted light; examined spectroscopically there was marked absorption towards the violet end of the spectrum, with a slight absorption in the yellow, but no bands. The addition of dilute acids to the alcoholic solution altered the colour to dirty yellow. Some of the dry extract was treated with water, and gently heated, a dark resin-like mass was insoluble; the aqueous solution had an acid reaction, and a fragrant odour. A few drops of dilute H Cl. were now added and the clear yellow solution filtered from insoluble matter, and agitated for a very brief period with chloroform. The chloroform, of a yellow colour, was separated; on evaporation the extract was not wholly soluble in dilute H Cl. The filtered acid solution gave with alkalies a pink colour, while brick-red flocks separated, not soluble in excess: the addition of dilute acids immediately destroyed the red colour. With potassio-mercuric iodide, phospho-molybdic acid, platinic and auric chlorides, and picric acid, marked amorphous precipitates were yielded.

The aqueous acid solution which had been agitated with chloroform for a short period only, was now rendered alkaline with ammonia and again agitated with chloroform. The chloroform was separated, and evaporated off at a gentle heat, the residue was dissolved in dilute H Cl., with alkalies white flocks separated, and the solution further gave precipitates with all alkaloidal re-agents.

These experiments would indicate that two principles were extracted, one possessing the properties of an acid, and yielding a red colour with alkalies; the other an alkaloid.

The reddish alkaline solution left after agitation with chloroform-ether, was gently heated to expel ether, and when cold acidified with dilute H Cl., when the colour changed to dirty green; the solution was then agitated with chloroform, which acquired an emerald-green colour. On evaporating off the chloroform a green varnish-like non-crystalline residue was left. The chloroform solution examined spectroscopically

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showed some absorption towards the violet end of the spectrum, but no bands. The liquid did not exhibit any fluorescence, and was of the same colour viewed either by reflected or transmitted light. The extract was readily soluble in alcohol; more readily soluble in ether than in benzol. The addition of a few drops of dilute H Cl. and water, dissolved the greater part of it, the resulting solution being of a dirty green colour. The addition of alkalies caused the separation of pink flocks, and the solution became of the same colour. A precipitate was also yielded with the usual alkaloidal re-agents. Subsequent addition of an acid caused the liquid to regain its original green hue, and the solution when again agitated with chloroform coloured it an emerald green. The action of alkalies on the green chloroform extract was extremly marked, the slightest trace of an alkali being sufficient to determine the production of the pink coloration. Boiled with alcoholic potash the red coloration of the liquid was not destroyed, but on the addition of dilute acids yellow flocks separated, which were soluble in chloroform with production of a yellow solution without any tinge of green. The aqueous solution was also yellow.

These experiments appear to indicate that the reddish alkaline solution contained an acid principle associated with an alkaloid. It would appear that the alkaloid contained in this second fraction was similar to the one to which reference has already been made. The two acid principles, however, do not appear to be identical: in the one case the chloroform solution of the acid was yellow, in the other emerald green. In their behaviour towards alkalies they also differed in the tint of the colour reaction. These principles do not appear to be of the nature of ordinary chlorophyll, but possibly they may be allied to the colouring matter stated to be present in certain lichens, &c., or to decomposition products of chlorophyll.

Separated resin B, was soluble in alkaline hydrates, and reprecipitated in brown flocks by acids. The resin was not further examined.

Aqueous residue C—The filtered solution was rendered alkaline with ammonia and agitated with chloroform-ether, brownish flocks separated. The separated chloroform-ether left on spontaneous evaporation a transparent yellowish varnish-like residue. In order to purify this extract it was dissolved in dilute acetic acid in which, with the exception of a few flocks it was wholly soluble. The filtered solution was agitated with chloroform several times; finally the liquid was rendered alkaline and again agitated with chloroform. On separating and evaporating off the chloroform, a faintly yellowish transparent residue was left; this residue was practically insoluble in water: it was easily dissolved by alcohol, and also soluble in ether, but the solutions did not crystallize on slow evaporation. The alcoholic solution was bitter; it did not exhibit fluorescence. In dilute acids, especially tartaric acid, the extract was soluble, the resulting solutions being bitter. With nitric, hydrochloric, sulphuric, acetic, and tartaric acids no crystalline compounds could be obtained. From an acid solution alkalies precipitated white flocks, which were redissolved by acids. An acid solution responded to all the ordinary alkaloidal re-agents. A solution in sulphuric acid after boiling did not reduce an alkaline copper solution. A solution of the extract in dilute hydrochloric acid was precipitated by platinic chloride in excess, the amorphous light yellow precipitate collected on a filter, well washed, and dried in a vacuum over concentrated sulphuric acid. Two determinations of the metal in this salt yielded 19·07 and 18·91 per cent., respectively, of platinum, which gives a mean of 18·99 per cent. of platinum. During ignition of the platinum salt there was a very strong odour of benzoic acid. This principle had the properties of an alkaloid; at present its ultimate composition has not been determined. The chloroform which was first agitated with the original alkaline aqueous solution, left a reddish varnish-like residue, which also gave all the reactions of an alkaloid, and which appeared to be similar to the principle separated from the alkaline solution; the alkaloid being thus separable both from an acid and an alkaline solution by chloroform, &c.

This alkaloid was doubtless the one which was found associated with the colouring principle, and to which reference has already been made. The colouring principle gave similar reactions to the one already described. The original aqueous alkaline solution left after agitation with chloroform was filtered, and then agitated with amylic alcohol. The amylic alcohol solution was of a deep claret colour: it was agitated with dilute hydrochloric acid. The amylic alcohol on evaporation left a light green varnish-like residue insoluble in water or in dilute hydrochloric acid. The addition of ammonia to the solid extract dissolved a portion, the solution being of a damson-red colour. The residue insoluble in ammonia was of a dirty brown hue. The addition of acids to the ammoniacal solution precipitated pale greenish flocks.

The hydrochloric acid solution of the amylic alcohol extract was of a deep brown colour, carbonate of soda was added, which precipitated brown flocks, and the solution agitated with amylic alcohol. The amylic alcohol became of a damson red colour. On evaporation a damson coloured varnish-like residue was left, partially soluble in water acidified with hydrochloric acid; the solution was strongly bitter and harsh: a trace of tannin was present. The addition of alkalies occasioned the precipitation of white flocks: with the ordinary alkaloidal re-agents precipitates were obtained. The principle possessed the properties of an alkaloid, but appeared to differ from the first one described in being more easily soluble in dilute acids, and in possessing a much more marked bitter taste, accompanied by harshness. The amount isolated was far too small to admit of any examination of its platinum salt.

The colouring principles which have been isolated by the action of amylic alcohol were probably similar to those obtained earlier in the analysis by the action of chloroform, &c. The aqueous residue left after the action of amylic alcohol was not further examined.

Commerce.—Not an article of commerce.

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COSCINIUM FENESTRATUM, *Colebr.*

Fig.—*Miers. in Hook. Bot. Mag.*, *t.* 6458; *Contrib. iii.* 22, *t.* 88. Tree Turmeric, False Calumba (*Eng.*).

Hab.—Western Peninsula, Ceylon. The stem.

Vernacular.—Jhár-kí-haldí (*Hind.*, *Bomb.*), Mara-manjal (*Tam.*), Dodamara-darasina (*Can.*).

History, Uses, &c.—The stem is said to have been long in use in Ceylon and Southern India as a bitter medicine, and as a yellow dye. We have not met with any account of it in native works; but there is reason to believe that it has sometimes been confounded with Darhalad, the stem of the Barberry. Ainslie was probably the first European physician who noticed it. He says:—"Mera Munjil is the Tamil name of a round yellow-coloured bitterish root, common in the bazaar, about one inch in circumference, employed in preparing certain cooling liniments for the head, and is also used as a yellow dye; it is brought from the mountains, but I have endeavoured in vain to ascertain the plant." Subsequently it attracted attention in Ceylon by being mistaken for Calumba, and some of it found its way to Europe, where it became known as False Calumba and Tree Turmeric; it is favourably noticed in the Pharmacopœia of India, and is used at the present time in the hospitals of the Madras Presidency as a bitter tonic. (*See Berberis.*)

Description.—Cylindrical woody stems, diameter 1 to 4 inches, covered with a pale corky bark; wood of a bright greenish yellow colour, and open porous structure, having no concentric rings, but conspicuous medullary rays; taste purely bitter. The wood is much less hard than that of the Barberry, and of a lighter colour.

Chemical composition.—Calumba wood was analysed by Perrins in 1853, and found to contain berberine. (*Phar. Jour.*, Vol. XII., pp. 180—500.)

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Commerce.—It is an article of commerce in Southern India only.

The Menispermaceous plants of minor importance sometimes used medicinally, are the following:—

Tinospora crispa, *Miers.*, extending from Sylhet and Assam to Pegu and Malacca. It possesses the bitterness and tonic properties of *T. cordifolia*, and is known by the same vernacular names.

Cocculus Leæba, *D. C.*, *Pluk. Am.*, *t.* 384, *f.* 4, a scandent shrub of the Punjab, Sindh, and Carnatic, which is also found in Afghanistan, Arabia and Persia, has bitter and tonic properties similar to those of *Tinospora cordifolia*. It is known in the Punjab and Sindh as Ullar-billar and Parvati.

Tiliacora racemosa, *Coleb.*, *Rheede Hort. Mal. vii.*, *t.* 3; *Miers.*, *Contrib. iii.* 76, *t.* 104, a climbing shrub found throughout tropical India and in Ceylon, is one of the three kinds of Mushadi used by the Telíngás as remedies for snake-bite. These three kinds are: Mushadi, *Strychnos Nux-vomica*; Naga-Mushadi, *Strychnos colubrina*; and Tiga-Mushadi, *Tiliacora racemosa*. Other vernacular names for this plant are Tiliakora (*Beng.*) and Bága-mushada (*Hind.*); it is bitter like others of the genus, and, it is hardly necessary to say, no antidote to snake poison.

Pericampylus incanus, *Miers.* Under the name of *Bárak-kánta*, slender Menisperaceous stems are sold in the Bengal bazars which appear to belong to this plant.

BERBERIDEÆ.

BERBERIS, ARISTATA, *DC.*

Fig.—*Bentl. and Trim.*, *t.* 16. Nepaul Barberry (*Eng.*), Vinettier aristé (*Fr.*).

Hab.—Temperate Himalaya, Nilgiri Mountains, Ceylon.

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B. LYCIUM, *Royle.*

Ophthalmic Barberry (*Eng.*), Vinettier tinctorial (*Fr.*).

Hab.—Western Himalaya from Garwhal to Hazara.

B. ASIATICA, *Roxb.*

Fig.—*Deless. Ic. Sel. ii., t.* 1.

Hab.—Himalaya, Behar on Parasnath. The stem, root-bark, extract and fruit.

Vernacular.—The stem, Dárhalad (*Hind., Bomb.*). The extract, Rusot, Raswanti (*Hind., Bomb.*), Raswal (*Sind.*). The fruit, Zarishk (*Pers., Hind., Bomb.*), Ambarbaris (*Arab.*).

History, Uses, &c.—Various species of Barberry occur on the Himalaya and Nilgiri mountains in India, at elevations between 6,000 and 10,000 feet. The wood (*Dáruharidrá*), extract (*Rasánjana*), and probably the fruit, have been used by the natives from a very early date. The Greeks were acquainted with the extract under the name of Indian Lycium as long ago as the first century; it would appear, though, that there were other kinds of Lycium in use at that time. (*Confer. Pharmacographia*, p. 34.*) The early Arabian writers were also acquainted with it by the name of Huziz-i-Hindi,† and mention its Indian name, which some of them derive from Ras, juice, and Uth (*uthna*, to boil). Hakím Abd-el-Hamid describes its manufacture from the powdered wood by exhaustion with water, filtration, and admixture with an equal bulk of cow's milk, the mixture being finally evaporated to the consistence of an extract, and enveloped in leaves; this method of preparation is the same as that described in Sanskrit works.

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* Dios. i. 117; Plin. 24, 76, 77; Cels. 5, 26; 6, 7; 8, 6; Scrib. Larg. Comp. 19, in the early stage of ophthalmia.

† They describe two kinds, *Maki* or the λύκιον of the Greeks, and *Hindi* or Indian; the former was derived from *Rhamnus infectorius*, the berries of which are used in dyeing leather yellow.

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Royle, in 1833, brought Rusot more prominently to the notice of Europeans; since then it has been pretty extensively employed as a tonic and febrifuge. The root-bark of Barberry is now official in the Pharmacopœia of India, it is noticed in the Tuhfat-el-muminín under the name of Árghis, and is said to possess all the properties of Mámírán. Surgeon-General Cornish, of Madras, states that the Nilgiri Barberry bark (Mullu-kulla-puttai *Tam.*,) has been used in the treatment of ague with good results. A similar opinion appears to be generally held by medical men in India. In the bazaars the stem, extract and fruit are always obtainable; the two first are considered cold and dry, and are prescribed in combination with other bitters and aromatics, as tonics and antiperiodics, especially when bilious symptoms and diarrhœa are present; they are also used in menorrhagia. Rusot mixed with opium, alum, rock salt, chebulic myrobalans, and various other drugs, is much used as an external application in inflammatory swellings, and is rubbed in round the orbit in painful affections of the conjunctiva; it is also used mixed with honey as an application to aphthæ, and abrasions and ulcerations of the skin, and mixed with milk it is dropped into the eye in conjunctivitis. The fruit is cooling and acid. Berberine in doses of 1½ grain given subcutaneously kills rabbits, with symptoms of prostration and fall of temperature; but a dose eight times as great given to them by the mouth has no action, and 15 grains only produce in man slight colicky pains and diarrhœa. Is said to cause contraction of the intestines and of the spleen, and to lessen oxidation in the blood. (*Lauder Brunton.*) The drugs which contain this alkaloid are very useful in malarial dyspepsia accompanied by a febrile condition.

Description and Microscopic structure.—Dárhalad occurs in pieces, 1 to 2 inches in diameter, covered by a soft, corky, light brown bark; beneath this is a hard layer of stony cells, forming a complete coating to the stem; this layer is marked by longitudinal furrows corresponding to the medullary rays, which are very prominent and close-grained, and contain many stony cells; between the rays are wedge-shaped portions of

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wood supplied with very large fenestrated vessels, and external to each wedge-shaped portion is situated a peculiar band of a pale yellow colour, which lies in contact with the stony envelope; there is a small close-grained central column, consisting of cells containing starch; all parts of the wood are impregnated with yellow colouring matter freely soluble in water.

Rusot is a dark brown extract of the consistence of opium, having a bitter and astringent taste, readily soluble in water, partly so in rectified spirit, forming a rich yellowish brown solution, which becomes bright yellow when diluted. It is prepared in Nipal and the Dhoon. Zirishk is a moist sticky mass of small black fruit, rather larger than English Barberries; most of them are abortive, but a few contain one or two oblong seeds about 3-20ths of an inch in length, with a thin roughish brown testa, beneath which is a membranaceous covering; the perisperm is yellow, embryo nearly as long as the perisperm, yellow, erect; cotyledons oblong; radicle subcylindric, inferior.

The root bark is brittle, externally light brown and corky, beneath the suberous layer it is of a dark brown, with a greenish yellow tinge, fibrous, and very bitter.

Chemical composition.—The bitter principle of Barberry root and wood is berberine, which it contains in great abundance. The fruit contains tartaric and malic acids. Berberine or berberia was first discovered by Chevallier and Pelletan (1826) in the bark of *Zanthoxylum clava Herculis, Linn.*, and named *zanthopicrit*; its identity with berberine was proved by Perrins (1862). A. Buchner, who obtained it (1835) crystallized from barberry root, believed it to possess acid properties, and named it berberin. It had been previously separated in an impure condition by Brandes (1825) and by Buchner (1830). G. Kemp (1841) noticed that it forms crystallizable compounds with various mineral and organic acids, but its alkaloidal nature was first proved by Fleitmann (1846). Since then it has been discovered in numerous plants of the orders

Berberideæ, Ranunculaceæ, Menispermaceæ, &c. Its composition is $C^{20}\ H^{17}\ NO^{4}$. (*Perrins.*) Berberine dissolves in strong sulphuric acid with a dingy olive-green, and in nitric acid with a dark brown-red colour. Solutions of its salts are precipitated greenish-brown by potassium ferrocyanide, and yellow by picric acid, phosphomolybdic acid, or chloride of gold, platinum or mercury; the precipitates are mostly crystalline or crystallize readily; the phosphomolybdate dissolves in ammonia with a blue colour. Dissolved in hot alcohol, the salts of berberine yield, with solution of iodine in potassium iodide, dark-green scales of metallic lustre and appearing reddish-brown in transmitted light; if an excess of iodine be employed: the crystals are of a red-brown colour in reflected light. Hydrochlorate of berberine assumes with chlorine a blood-red colour. (*Buchner.*) This behaviour furnishes a delicate test, by means of which, according to Klunge, berberine may be detected in over 200,000 parts of solution; brucine, which gives a similar colour with chlorine, yields with acids colourless solutions. Fused with potassium hydrate, berberine is decomposed, yielding two acids, one of which is sublimable, the vapours having the odour of chinolin. (*Hlasiwetz and Gilm.*) Oxyacanthine, $C^{32}\ H^{46}\ N^{2}\ O^{11}$, remains in the mother liquor from which the berberine salt has been precipitated by an acid. It is a white alkaloid, turning yellow in sun-light, nearly insoluble in water, and has a bitter taste and alkaline reaction; it is soluble in alcohol, less so in ether, but freely in chloroform, benzol, fats and volatile oils. Sulphuric acid colours it brown-red. Nitric acid imparts a yellow and, when heated, a purple colour. Berbamine $C^{18}\ N^{19}\ O^{3}\ N$ and at least another alkaloid are also contained in the root. (*Cf. Stillé and Maisch. Nat. Disp., 3rd Ed., p.* 315, *On Berberine, by W. H. Perkin, jun., Journ. Chem. Soc., Feb.* 1889.)

Commerce.—Dárhalad comes to the plains from Northern India and from the Madras Presidency. Rusot and Zirishk from Northern India. Value, Dárhalad, Rs. 3½; Rusot, Rs. 8-9 per maund of 37½ lbs.; Zirishk, Re. ¼ per lb.

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PODOPHYLLUM EMODI, *Wall.*

Fig.—*Jacq. Voy. Bot. ii.*, t. 9.

Hab.—Interior ranges of the Himalaya, Sikkim, Hazara, Cashmere.

Vernacular.—Pápra *or* Pápri, Bhavan-bakra *or* bakra, Chimyaka (*Hind.*).

History, Uses, &c.—The genus Podophyllum contains four known species, one Himalayan, one American and two Chinese. The Indian species inhabits shady valleys in the inner ranges of the Himalaya, and is very abundant in Kunawur and Cashmere. The remarkable appearance of its bright red fruit would lead one to suppose that it must have attracted the attention of the Hindus, and judging by the Hindi names *Pápra* and *Bhavan-bakra* it is probable that it was one of the bile-expelling plants, described by Sanskrit writers under the names of *Parpata* and its synonym *Vakra.* In Hindi the Sanskrit *parpata* becomes *pápra* and *vakra* changes into *bakra*; the prefix *bhavan* probably means "hill" and the Hindi name would thus signify "hill vakra" as distinguished from *kshetra-vakra* or *kshetra-parpata*, field vakra or parpata, a name applied to one or more species of Oldenlandia. The modern medical literature of India contains hardly any information about this plant. A specimen of the root was forwarded to the Committee for investigating Bengal drugs, by Dr. Falconer about fifty years ago, but no examination of it appears to have been made. The plant is mentioned in the Pharmacopœia of India as a possible source of Podophyllin, and Stewart says that the fruit is used medicinally in Lahoul.

Description.—Stem or scape 6 to 12 inches, erect, stout, herbaceous; leaves 2, vernal, alternate, long-petioled, plaited and deflexed in vernation, 6 to 10 inches in diameter, orbicular, 3 to 5 lobed to the middle or base; lobes cuneate, acutely serrate; peduncle terminal in bud, then apparently supra-axillary or inserted on the petiole of the upper leaf; flowers 1 to [illegible] inch in diameter; sepals very deciduous; petals 6, sometimes 4 (*Royle*), obovate-oblong; berry 1 to 2 inches long, ellipsoid, red. (*Fl. Br. Ind.*) The root agrees with that of *P. peltatum* in most particulars, but differs in the intervals of the knots whence the aerial stems are given off. The rhizome is more or less cylindrical, crowded above with tuberosities, marked by depressed oval or circular scars, and giving off numerous simple rootlets below. The terminal bud is enclosed in whitish papery sheaths. The colour is yellowish-brown, paler in the rootlets. The fracture is short and mealy, disclosing a white section, with a circular arrangement of yellow vascular bundles, and bounded on the outside by a thin brown cortical layer.

Chemical composition.—The powdered root was macerated in rectified spirit for four days, and the tincture evaporated to dryness, weighed 25 per cent. of the drug. This extract was well washed with water, which removed sugar and bitter colouring matter to the extent of 15 per cent. The remaining 10 per cent. of resin or resins was dried at a low temperature and had a bright brownish yellow colour. The reactions of the resin with tests, and its solubility in chloroform, ether, and diluted alkalies were very similar to those of the official resin of *P. peltatum*.

Half a grain (·035 grm.) taken in the evening produced unmistakably a cathartic action the first thing next morning. A slight griping was experienced.

NYMPHÆACEÆ.

NELUMBIUM SPECIOSUM, *Wight.*

Fig.—*Wight, Ill. i., t.* 9; *Bot. Mag., t.* 903; *Rheede, Hort. Mal. xi.,* 30, 31. Egyptian Lotus (*Eng.*), Nélumbium magnifique (*Fr.*).

Hab.—India, Persia, Ceylon, Siam, Cochin-China, Philippines, Moluccas, China and Japan. The flowers

Vernacular.—Kamal, Kanval (*Hind.*), Alli-támara (*Tel.*), Nyadale-huvu (*Can.*), Kamala (*Mar.*), Sevaka (*Goa.*), Paban (*Sind.*), Ambal (*Tam.*).

History, Uses, &c.—This is a classical plant amongst the Hindus and Egyptians. The world at its creation is likened to a Lotus flower floating on water. Om! mani padme. Om! the pearl of creation is in the Lotus. It is emblematic of the heavens, Brahma is supposed to reside on a Lotus flower in a sea of milk, and to sleep six months of the year, and watch the other six months; an allusion to the seasons in which Brahma represents the Sun. Mr. O. C. Dutt, in his Hindu Materia Medica, speaks thus of it:—"These beautiful plants have attracted the attention of the ancient Hindus from a very remote period, and have obtained a place in their religious ceremonies and mythological fables; hence they are described in great detail by Sanskrit writers. The flowers of *N. speciosum*, called *Padma* or *Kamala*, are sacred to Lakshmi, the goddess of wealth and prosperity. The white variety of this plant is called *Pundarika*, the red *Kokanada*, and the blue *Indivara*. The entire plant, including root, stem and flowers, is called *Padmini*. The torus or receptacle for the seed is called *Karmikara*, and the honey formed in the flowers *Makaranda*. The filaments round the base of the receptacle pass by the name of *Kinjalka*, and the leaf stalk by that of *Mrinala*." *N. speciosum* is the κυαμος ἀιγὺπτιος of Theophrastus. The Arabians and Persians, under the name of *Nilufer*, which, they say, is a corruption of an Indian name, and derived from Nila, water, and Phala, fruit, describe the several varieties of Nelumbium and Nymphæa, and do not appear to consider the flowers of the former plant in any way superior to the latter. They direct the white and blue kinds to be preferred. Both Hindus and Mahometans consider the flowers to be especially cooling and astringent, and consequently prescribe them in a variety of disorders which are supposed to proceed from heated humours, such as sanguineous fluxes from the bowels, &c.; they are given in decoction with liquorice or in the form of a syrup

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containing ½ a part of the dried flowers, 1 part sugar, and 5 parts water, dose 2 to 3 drachms. A powder is also used. As an externally cooling application Lotus flowers are made into a paste with sandalwood or emblic myrobalans.

The seeds of *N. speciosum* (Kamal kakrí),* and of *Euryale ferox* (Makhána) are used as articles of diet. In times of scarcity the roots and scapes (bishi) of *N. speciosum* are also made use of, but they are bitter and unpalatable. The starch contained in the thick rhizome, separated by rasping and washing, constitutes a sort of arrowroot used by the Chinese, under the name of *Gaan-feen*. (*D. Hanbury.*)

Description.—The calyx consists of four to five deciduous sepals; the corolla of numerous deciduous petals, arranged in several rows; the stamens are numerous, in several rows, attached with the petals to the base of the receptacle; the stigma is sessile; the dry flowers have a brown colour; the seeds are black and like small acorns.

Chemical composition.—The rhizome of *Nymphœa alba* contains an alkaloid which appears to be identical with that obtained from *Nuphar luteum* in its chemical and physical properties, as well as in its behaviour towards group re-agents, but in their colour reactions there is a decided difference; inasmuch as the alkaloid of Nymphæa does not give the green reaction with dilute sulphuric acid which *nupharine* does, and gives the following reactions which are not given by that alkaloid. Concentrated sulphuric acid and potassium chromate colour its solution first red-brown and after some hours clear green; concentrated sulphuric acid alone produces a red brown which passes into grey. Frohde's re-agent colours it first red, then dirty-green. The alkaloid is not present in the blossoms or seeds, it is tasteless, but its acid solution is intensely bitter. The formula is $N^2 C^{18} H^{24} O^2$, the same as that given by Pelletier and Couerbe to menispermine and paramenispermine, and the three alkaloids are probably isomeric.

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* Bákla-i-kubti or Bákla-i-nabti of Persian writers (Coptic bean).

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The tannins of Nymphæa are notable for yielding many secondary products, which have been individually found in other tannins, but their presence together has not been hitherto noted. Ellagic and gallic acids are easily obtained; another substance, which rapidly absorbs oxygen from the air, and passes into a body of the nature of phlobaphene; and a second substance, which by similar absorption of oxygen passes into two bodies, or assumes two phases with properties similar to chlorophyll.

The rhizome and seeds of Nymphæa also contain resins, glucose, metarabin and fat, besides other substances common to plants. (*W. Grüning, Archiv. der Pharm.* [3], XX., 582—605 and 736—761; *Pharm. Journ.* [3], XIV., 49.)

Commerce.—The seeds are imported from Persia in large quantities as an article of diet. The fresh flowers are brought to market in August for use in the temples. The dried flowers sold in shops as Kamal are generally those of Nymphæa.

PAPAVERACEÆ.

PAPAVER SOMNIFERUM, *Linn.*

Fig.—*Eng. Bot.* 2145; *Bentl. and Trim.*, *t.* 18. Garden Poppy (*Eng.*), Pavot somnifére (*Fr.*).

Hab.—Cultivated in India. The juice, capsules, petals and seeds.

Vernacular.—Opium, Afiyún, Afím (*Hind.*), Aphim, Appo (*Bomb.*), Abini (*Tam.*). *Poppy seed,* Kashkásh (*Hind.*), Khasḳhas (*Bomb.*), Gashagasha (*Tam.*). *The capsules,* Post (*Hind.*, *Bomb.*), Postaka-tol (*Tam.*).

History, Uses, &c.—Opium is not mentioned by the older Hindu writers; in works of later date it is named in Sanskrit Ahiphena. If we trace the history of the drug, we find that it was known to the Greeks in the beginning of the third century, B. C., and was probably first collected and prepared in Asia Minor. The Arabians next became acquainted with it, and converted the Greek name Opion into Afiyún; some of their writers mention this derivation, and say that the Greek word means soporific.* It is generally supposed that the Persians and Indians became acquainted with opium through the Arabians; but some Persian writers suppose that the Tiryák which Rustum obtained from Kaikáous to give to Sohráb was opium. For a further account of the history of the drug, the Pharmacographia and other standard works on Materia Medica may be consulted. The poppy generally cultivated in India is the *P. somniferum* var. *album,* with white flowers and white seeds: but a red-flowered and black-seeded variety is met with in the Himálayas The principal opium-producing region of British India lies in the central tract of the Ganges, bounded by Dinajpur in the east, Hazaribagh in the south, Gorakhpur in the north, and Agra in the west, thus including the districts of Behar and Benares. In 1886-87, 919,852 bighas of land were under poppy cultivation in those districts. The next important opium-producing region embraces the table lands of Malwa, and the slopes of the Vindhya Hills: it is stated that the variety grown there is the *P. glabrum.* The poppy is also grown, but to a smaller extent, throughout the plains of the Punjab, but less commonly in the N.-W. Provinces. In the valley of the Beas, east of Lahore, it is cultivated up to an altitude of nearly 7,500 feet. Most of the outer districts grow poppy to a certain extent, and produce opium for local use. But the drug prepared in the Hill State and in Kulu, forms a staple article of trade for that region. Opium is also produced in Nipal, Baisahir and Rampur, and at Doda Kashtivar, in the Jammu territory: in the Nundidrug district in Mysore, in the Baldasuch district of West Berar, and in Assam.

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* οπιον. Latin, Opium or Opion. Plin. 20, 76. Poppy juice The Arabian lexicographers regard the word as Arabic, the author of the Kámús derives it from the root فين, others from افن.

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The revenue derived by Government from the opium monopoly is obtained by two principal means, by allowing the drug to be manufactured by licensed cultivators in the Patna and Benares districts, the opium being purchased by Government at a fixed rate; and, secondly, by the impost of a heavy duty on opium manufactured in native States, but brought in transit to a British port for exportation. The former system obtains in Bengal, the latter in Bombay The number of licensed cultivators in Bengal always exceeds a million.

The opium industry in Bengal is thus completely under the control and monopoly of Government, and the districts producing the drug are divided between two agencies—one for Bihar, and having its head-quarters at Patna, the other for Benares, at Ghazipore. The opium prepared in the Benares Agency is for the greater part taken by the cultivators to sub-factories (*Kothis*), of which there are several in each district, where the drug is weighed and examined, and finally consigned in bulk to the head factory at Ghazipore. The opium prepared, however, in the home divisions, near the head factory, is taken by the cultivators direct to Ghazipore. The receipt of opium at the head factory is thus conducted under two systems, the first described being termed Challán, and the second Assamiwar. In the Bihar Agency the whole of the opium received at the head factory is Challán.

The lands selected for poppy cultivation are usually in the vicinity of villages. The early sowings are made about the middle of November, and the second and third by the end of December. The seeds germinate in 10 to 12 days. In the Benares district, in some instances in January, but generally in February and March, the plants are mature, and the capsules fit for scarification. The capsules then become slightly coated over with a fine transparent white bloom, and are less yielding to the touch when pressed. Another method of recognising maturity, is when juice exudes on breaking off the series of stigmata formed on the apex of the capsule. When the plant is in full flower, and just before the time for the fall of the

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petals, they are collected in the following manner. The forefinger and thumb encircle the stem just beneath the capsule, and with the other fingers drawn inwards a kind of tube is formed: the fingers are then gently raised straight over the capsule, and if the petals are matured, they come off. They are never plucked off, as it would injure the capsule. The petals are manufactured into what are technically called *leaves.* A circular ridged earthen plate, about 10 to 14 inches in diameter, is placed over a low fire, some petals are then spread on the heated convex surface, and as soon as their glutinous juice exudes, others are added, and pressed with a damp cloth pad, till they have adhered together. The leaf is then removed and allowed to dry. "Leaves" vary in diameter from 6 to 12 inches, and in thickness from ·3 to ·025 inches.

A few days after removing the petals the capsules are incised. The operation takes place in the afternoon, and is performed by bunches of forked blades (*nashtars*). The blades are bound together with cotton thread, which is at the same time passed between the blades so as to separate the cutting-ends by about $\frac{1}{16}$ inch, while the protrusion of the points is limited to about $\frac{1}{12}$ inch, which thus determines the depth of the incision. The incisions are made vertically* from base to summit, usually along the eminences of the capsule, marking the attachment of the internal dissepiments and penetrating the epicarp and sarcocarp. The number of incisions required to complete the exudation of all the juice varies with size of capsule, from 2 to 6 or even 8; and two to three days are allowed to alternate. A milky juice exudes almost immediately after scarification; the water it contains evaporates slowly, and the outer portion of the tear drying somewhat, thickens a little and acquires a rose-red colour, while the inner portion is semi-fluid and of a pinkish tinge. The collection of the exuded juice takes place early on the morning following the scarification. In Bengal it is performed by a small sheet iron scoop (*sutwa,* सुतवा), which is twice drawn briskly upwards over each incision, and a finger run over the incisions to close them. The opium thus collected is from time to time emptied into an earthen or brass vessel.

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* In some parts of Bengal horizontal incisions are adopted as in Asia Minor. In Mysore thorns are used for scratching the capsules.

The fresh opium as collected contains about 50 per cent. of moisture. The average quantity yielded per scarification is perhaps 10 grains, while a single healthy plant under favourable circumstances yields about 75 grains opium in from 5 to 8 scarifications. The average yield of opium per bigha obviously varies from year to year. In 1886-87, the average produce in Benares was 5 seers 3 chittacks and 2 katchas and in Bihar 4 seers $5\frac{1}{4}$ chittacks.

When the vessel containing recently collected semi-fluid opium is tilted and allowed to remain for some time in that position, a blackish fluid having a peculiar odour separates: this is termed *pasewha* (पसेवहा). *Pasewha* is not always found in opium; it is only produced under peculiar atmospheric conditions. It is never present when a strong westerly wind blows, or when no dew is deposited. The yield of opium under these circumstances is small owing to the incision in the capsule being quickly sealed up by the juice, which rapidly concretes, and is entirely free from *pasewha*. Where the deposition of dew on the other hand is considerable, *pasewha* is formed. The *pasewha* present in opium is carefully separated; if allowed to remain, the opium is injured in colour, texture, and aroma, and it becomes unsuited for the China market, although the drug is perfectly pure. Opium containing any amount of *pasewha* is subject to "penalty batta," which consists in a deduction of from $\frac{1}{64}$th to $\frac{5}{64}$ths of the value of the whole weight of opium tendered by the cultivator.

The opium freed partially or completely from *pasewha* is exposed to the air in the shade, and turned occasionally so as not to injure the grain, until it reaches approximately the required consistency, when it is taken to the head or one of the sub-factories, as already described.

The stems and leaves of the poppies are left standing after removal of the capsules, till perfectly dried by the hot winds, when they are collected and crushed into a coarse powder, termed *trash*, employed for packing opium for the China market.

The opium, as received from the cultivators at the sub-factories, varies in consistence, and is divided into six classes, while the final classification of the drug is determined at the head factory, where the opium is finally classified in 12 classes. The classification of the drug depends upon the percentage of solid opium present when a sample is dried at 200° F. Thus opium containing 20 per cent. of moisture would be termed opium of 80 degrees consistence. In the classification of opium each class of opium has a range of three degrees. The opium received into the factory may vary in consistence from 81 degrees and upwards to 50 degrees or less, all opium containing only 50 per cent. and under of solid opium being included in one class, called "*Páni-ámez*," while opium above 81 degrees is designated "above *Bála-báshi dar awal*." The assay of opium for moisture is performed by placing 100 grains on a plate, which is placed on a steam table, the opium being constantly rubbed with a spatula till it is reduced to powder. The temperature to which the opium is exposed does not exceed 200° F.

The opium received into the head factory is, after careful examination for adulteration, and assay for moisture, placed in large stone vats, according to the class to which it belongs. The classification of opium is of considerable consequence, because Benares and the Bihar Factory have each to prepare opium for the China market of a fixed consistence, the standard for Bihar being 75 degrees and for Benares 70 degrees consistence: and it is by the admixture of opium of various degrees of consistence that these standards are maintained. Although the standards for the two districts are fixed, a latitude of ·5 of a degree above or below the standard is permitted, as it is practically impossible to exactly hit off the exact standard when manipulating such large quantities of the drug—nearly three tons—as are daily required for caking. In very dry seasons, the opium being of high consistence, a portion may have to

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be caked one or more degrees above standard, but under such circumstances the standard weight of opium 1 seer 7½ chittacks must be placed in each cake, no reduction in weight being allowed for increase in consistence. Taking the Benares Agency for example, where the daily manufacture of cakes amount to about 20,000, to cake at one degree above the limit would entail a loss to Government of Rs. 1,260 a day.

The opium received into the head factories is employed for the manufacture of China provision, abkari, and medicinal opium, while at Ghazipur certain varieties are used for the extraction of alkaloids.

To prepare opium for the China market a certain number of vats are selected, and samples assayed for moisture. The contents of those vats which will give when mixed together in certain proportions opium of 69·3 or 69·4 degrees for Benares, are equally distributed over other vats, called alligation vats, the opium is well mixed by men walking about in it and kneading it with their feet and with rakes. The opium is then removed to the caking vats, and is again kneaded on the following morning, when samples from each vat are assayed; should the whole of the assays come out above 69·5° and under 70·50°, the opium is ready for caking.

The manufacture for the China market consists in enveloping a portion of standard opium in leaves agglutinated by a mixture of opium and water called *lewa* (लेवा). *Lewa* consists of dirty but otherwise pure opium broken down in water in which the opium vessels have been washed, and which is technically called *dhoi* (धोई), about 8 per cent. of *pasewha* being added to render the *lewa* glutinous. *Lewa* contains from 52·5 to 53·5 per cent. of solid matter. The opium, leaves, and *lewa* are accurately weighed for each cake.* The finished cake resembles a Dutch cheese in size and shape ; it is rolled in a little fine *trash*

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* At Benares the following materials are used for making a cake :—Standard opium at 70 degrees, 1 seer 7·5 chittacks ; Lewa at 53°, 4·5 chittacks ; Leaves, ·5 chittacks ; Water, ·5 chittacks ; *Trash*, ·25 chittacks—Total weight on day of manufacture, 2 seers 1·75 chittacks.

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and placed in an earthen cup of the same size as the mould in which it was originally made, and exposed to the sun; this exposure is continued for two or three days, the cakes being constantly turned and carefully examined. One man assisted by a child will turn out about 70 cakes in four hours, though some can turn out 90 to 100. After having dried the cakes partially by exposure to the sun, they are removed, still in thin earthen cups, to the cake godowns, where they are kept on racks, and constantly turned and rubbed with dry *trash*. In September the cakes are finished at the Benares Factory by placing a fine *Chandni* leaf* on each, weighing ·43 of a chittack with ·5 of a chittack of *lewa*. At this period all bulged and grub-eaten shells, &c., are repaired. By October† they are dry to the touch, and are packed in chests, furnished with a double tier of wooden partitions, each tier with twenty square compartments for the reception of as many cakes, the cakes being steadied and lightly packed round with *trash*. All the joins in the box are secured by cloth and pitch, and a cover of coarse canvas sewn on.‡

Abkari opium is the opium prepared for local consumption; it is pure opium dried by exposure to the sun in shallow wooden trays, with constant stirring, until its consistence is 90°; it is then accurately weighed into quantities of one seer, which are pressed into square blocks; the blocks are wrapped, in Nipal paper, slightly oiled with poppy oil, and packed in boxes containing 60 cakes.

Medicinal opium is pure opium of good colour and aroma, and free from *pasewha*. It is reduced to powder by being placed on plates which are heated on a steam table, and the

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* A person accustomed to handle Indian opium can, by the appearance imparted to a Benares cake by this last leaf, distinguish it from a Patna one.

† Theoretical weight of a Benares cake fit for packing: Standard opium in cake at 70°, 1 seer 7·5 chittacks; Opium in *lewa*, 3·75 chittacks; Leaves, 5·43 chittacks; Fine *trash*, ·5 chittacks.

‡ A packed chest of Benares opium weighs 3 maunds 26 seers 1 chittack, and contains 40 cakes, weighing on the average 2 maunds 8 chittacks.

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opium constantly rubbed with a steel spatula till a dry powder is obtained.

*Adulteration of Opium.**—The articles used by the cultivator for adulterating opium may be classified as follows :—

1. Adulteration with fresh green parts of the poppy plant, including watery extracts.

2. Adulteration with foreign extractives, and vegetable matter, such as the inspissated juice of the *Opuntia Dillenii* and *Calotropis gigantea,* extracts of the tobacco plant, datura and hemp.

3. Gums and resinous matters. A gum resin derived from different varieties of *Ficus,* and called *Lassa.* The resin of *Shorea robusta* (sál), pulp of Bael fruit, gum from seeds of Talimkhana (*Hygrophylla spinosa*), tamarind pulp, gum from *Acacia arabica.*

4. Farinaceous admixtures, including linseed, poppy seed, seeds of leguminous plants, and esculent tubers and roots. The starchy matter is often heated for a long time before being used ; hence iodine reaction may fail.

5. Vegetable substances containing tannin and colouring matters. Catechu, "Gáb" (*Diospyros embryopteris,* juice of fruit), turmeric, flowers of *Bassia latifolia,* betel-nut, extract of pomegranate bark.

6. Saccharine matter; vegetable oils and ghee; soot, charcoal, and semi-burnt opium; cotton and paper; cowdung; earthy and siliceous matter; pounded burnt bricks; impure carbonate of soda, &c.

Opium found to be seriously adulterated may be confiscated, or a fine can be levied. At the Benares Agency, during 1868-69, the gross receipt of opium of all kinds amounted to 39,893 maunds, out of which fines were levied on 181 maunds, as being "inferior opium," and on 71 maunds on account of

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* Memorandum by the late Surgeon-Major Sheppard, Principal Assistant Opium Agent, Benares.

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pasewha, while 34 maunds were confiscated owing to serious adulteration.

Manufacture of Alkaloids.*—The opium used at Ghazipore for manufacture of alkaloids, consists of confiscated opium so adulterated as to be unfit for provision or abkari purposes; adulterated contraband opium and *dhoi*. The average amount of opium used, taking the figures for three years from 1886 to 1888, amounts to about 16,626 lbs. annually.

The yield of alkaloids during 1887-88 was as follows:—

Hydrochlorate of Morphia...	242 lbs.	14½ oz.
Acetate „ „ ...	34 „	11 „
Sulphate „ „ ...	19 „	10½ „
Codeine	30 „	10¼ „

No narcotine has been manufactured since 1881-82, there being no demand for it. In 1879-80, the yield was 188 lbs.

Morphia is manufactured by the Gregory-Robertson system modified in a few minor details. The opium is steeped in small vats with water, and the liquor passed through blanket filters: the maceration of the residue is repeated until the filtrate is colourless. The mixed filtrates are evaporated by steam to a thin syrupy consistence. Chloride of calcium is then added in the proportion of about 5 per cent. of the weight of the opium used, and the mixture evaporated until it solidifies on cooling. The crystalline magma is then powerfully pressed. The dry cake is dissolved in boiling distilled water, filtered, and the filtrate evaporated until it solidifies on cooling. Pressure is again applied to the magma; and the resulting cake again dissolved in water, and this process is repeated perhaps a dozen times, until the cake is almost white. The expressed mother liquors are again worked up for morphia. The nearly white cake is finally dissolved in boiling distilled water, and ammonia in slight excess added. The precipitate is

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* Mr. Gregory, Offg. Principal Assistant Opium Agent, Benares, has kindly furnished the information regarding the manufacture, &c., of alkaloids as conducted at Ghazipore.

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collected and worked with cold distilled water, until it ceases to give the reaction for chlorides. The precipitated morphia is then neutralized with hydrochloric acid, and the solution crystallised. The crystals are pressed, and mixed with twice their weight of water, and wood charcoal* added in the proportion of 2 oz. to each lb. of the mass. This mixture is heated to 200° F. for about twenty minutes, and then filtered. On cooling the hydrochlorate of morphia separates in crystals. Codeia is obtained from the mother liquor left after the precipitation of the morphia by ammonia. The liquor is concentrated to a moist mass and strongly pressed; the cake is moistened with water and again pressed, and this is repeated until the alkaloid is nearly white. The cake is broken up in water, and caustic potash added in considerable excess. The codeia separates in crystals slightly coloured. It is finally purified by crystallisation from alcohol. Narcotine is obtained by digesting with hydrochloric acid the insoluble residue left by the action of water on opium, and precipitating with ammonia. The impure narcotine is purified by repeated solution and crystallisation from alcohol, and decolorised by charcoal.

The opium used in Western India is known as Malwa; it is collected in the province of that name, and, besides supplying local markets, is largely exported to China. The following account of the cultivation of the Poppy in Malwa is given by Dr. Impey, who resided there for three years:—"For the successful cultivation of opium, a mild climate, plentiful irrigation, a rich soil, and diligent husbandry, are indispensable. In reference to the first of these, Malwa is placed most favourably. The country is, in general, from 1,300 to 2,000 feet above the level of the sea; the mean temperature is moderate, and range of the thermometer small. Opium is always cultivated in ground near a tank or running stream,

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* Charcoal from the *Butea frondosa* is used; it was selected on account of its comparative freedom from saline matter. Though wood charcoal possesses feebler decolorizing power than animal, it had to be used on account of native prejudice against animal charcoal.

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so as to be insured at all times of an abundant supply of water. The rich black loam supposed to be produced by the decomposition of trap, and known by the name of cotton soil, is preferred for opium; though fertile and rich enough to produce thirty successive crops of wheat without fallowing, it is not sufficiently rich for the growth of the poppy until well manured; there is, in fact, no crop known to the agriculturist, unless sugar-cane, that requires so much care and labour as the poppy. The ground is first four times ploughed on four successive days, then carefully harrowed, when manure, at the rate of from eight to ten cart-loads an acre, is applied to it; this is scarcely half what is allowed to a turnip crop in Britain. The crop is after this watered once every eight or ten days, the total number of waterings never exceeding nine in all. One bigha takes two days to soak thoroughly in the cold weather, and four as the hot season approaches. Water applied after the petals drop from the flower causes the whole to wither and decay. When the plants are six inches high, they are weeded and thinned, leaving about a foot and a half betwixt each plant; in three months they reach maturity, and are then about four feet in height if well cultivated. The full-grown seed-pod measures three and a half inches vertically, and two and a half in horizontal diameter. Early in February and March the bleeding process commences. Three small lancet-shaped pieces of iron are bound together with cotton, about one-twelfth of an inch alone protruding, so that no discretion as to the depth of the wound to be inflicted shall be left to the operator; and this is drawn sharply up from the top of the stalk at the base to the summit of the pod. Three sets of people are so arranged, that each plant is bled all over once every three or four days, the bleedings being three or four times repeated on each plant. This operation always begins to be performed about three or four o'clock in the afternoon, the hottest part of the day. The juice appears almost immediately on the wound being inflicted, in the shape of a thick, gummy milk, which is soon thickly covered with a brown pellicle. The exudation is greatest over-night, when the incisions are washed and kept open by the dew. The opium thus derived is scraped off next morning with a blunt iron tool resembling a cleaver in miniature. Here the work of adulteration begins—the scraper being passed heavily over the seed-pod, so as to carry with it a considerable portion of the beard, or pubescence, which contaminates the drug and increases its apparent quantity. The work of scraping begins at dawn, and must be continued till ten o'clock; during this time a workman will collect 7 or 8 ounces of what is called 'chick.'* The drug is next thrown into an earthen vessel, and covered over or drowned in linseed oil at the rate of two parts of oil to one of chick, so as to prevent evaporation. This is the second process of adulteration, the ryot desiring to sell the drug as much drenched with oil as possible, the retailers at the same time refusing to purchase that which is thinner than half-dried glue. One acre of well culivated ground will yield from 70 to 100 pounds of chick. The price of chick varies from 3 to six rupees a pound, so that an acre will yield from 200 to 600 rupees' worth of opium at one crop. Three pounds of chick will produce about two pounds of opium, from the third to the fifth of the weight being lost in evaporation. It now passes into the hands of the Bunneah, who prepares it and brings it to market. From 25 to 50 pounds having been collected is tied up in parcels in double bags of sheeting cloth, which are suspended from the ceiling so as to avoid air and light, while the spare linseed oil is allowed to drop through. This operation is completed in a week or ten days, but the bags are allowed to remain for a month or six weeks, during which period the last of the oil which can be separated comes away, the rest probably absorbs oxygen and becomes thicker, as in paint. This process occupies from April to June or July, when the rains begin. The bags are next taken down, and their contents carefully emptied into large vats from 10 to 15 feet in diameter and six or eight inches deep. Here it is mixed together and worked up with

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* चिक *chick*, a common term in Western India for the sticky juice of any plant.

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the hands 5 to 6 hours, until it has acquired an uniform colour and consistence throughout; and become tough and capable of being formed into masses. This process is peculiar to Malwa. It is now made up into balls of from 8 to 10 ounces each, these being thrown, as formed, into a basket full of the chaff of the seed pods. It is next spread on ground previously covered with leaves and stalks of the poppy; here it remains for a week or so, when it is turned over and left to consolidate, until hard enough to bear packing; it is ready for weighing in October or November, and is then sent to market. It is next packed in chests of 150 cakes, the total cost of the manufacture at the place of production being about rupees 14 per chest." The greater part of the opium produced in Malwa is consumed by opium-eaters. Besides linseed oil Malwa opium is often adulterated with starch, and inferior samples with some of the substances already mentioned as used to adulterate opium in Bengal.

Description.—China investment or provision opium varies in colour according to the amount of *pasewha* (पसेवहा) present, and the district from which it has been obtained. The colour may vary from dark brown to rich dark chestnut; when viewed in thin layers, it is translucent; odour rich, agreeable, and somewhat fruity; taste hot and bitter. If a small portion be rubbed between the finger and thumb for a few seconds, it draws out into long threads, and from their number, fineness, and tenacity, the Chinese form their first estimate of the value of the drug. The Abkari opium, in square cakes, has a very much darker colour and less pleasant odour than provision opium, its consistence is also greater, and it can with some little difficulty be moulded between the fingers. The medicinal opium occurs as a chocolate coloured finely granular powder.

Malwa opium occurs in round or slightly flattened balls, weighing about ten ounces each, and covered externally with some of the chaff from the capsules; its consistence is about the same as that of average Smyrna opium; appearance of section homogeneous; colour dark brown; odour like that of

Smyrna opium. Poppy capsules as found in Indian commerce are much broken, and appear to have been beaten to extract the seeds, the fragments are marked by triple or quadruple incisions, usually longitudinal, but sometimes transverse. The seeds are reniform, very small, usually white, but sometimes grey, a little over one millimetre long. The testa is composed of six-sided scale-like cells, the albumen is oily, and encloses a curved embryo composed of two cotyledons and a radicle of equal length; the taste is sweet and oily.

Poppy oil is of a pale golden colour, inodorous, of agreeable flavour and soluble in 25 parts of cold and 6 of boiling alcohol. Its chemical constitution is similar to linseed oil; saponification equivalent 290. Its specific gravity is ·924 to ·927 at 15·5 C.; it solidifies at —18° C.; does not easily become rancid; the oil is present in the seeds to the extent of about 50 per cent., but by the native process much less than this is extracted, the yield under favourable circumstances amounting to about 14 ozs. from 4 lbs. of seed. It is used as a substitute for olive oil by the Military Medical Establishments, but being a drying oil it is not nearly so well suited for medicinal use as the oil of *Arachis hypogæa*. It is also used to adulterate olive oil.

Microscopic structure—Opium of good quality, macerated in glycerine, shows numerous prismatic crystals, some of them in tufted bundles; a few large, refractive globular bodies are seen which have a resinous appearance, and here and there objects which appear to be starch grains; the remainder consists chiefly of amorphous particles, but mixed with them are some fragments of vegetable tissue (epidermis and fibre from the capsules). Of eight kinds of Indian opium examined by Flückiger five contained distinct crystals, two are described as not distinctly crystalline, and of one it is not stated whether it was crystalline or not. His sample of Malwa opium must have been of inferior quality, as the best shows numerous crystals.

Chemical composition.—The alkaloids which have been separated from opium are Hydrocotarnine, $C^{12} H^{15} NO^{3}$;

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Morphine, $C^{17} H^{19} NO^{3}$; Pseudomorphine, $C^{17} H^{19} NO^{4}$; Codeine, $C^{18} H^{21} NO^{3}$; Thebaine, $C^{19} H^{21} NO^{3}$; Protopine, $C^{20} H^{19} NO^{5}$; Laudanine, $C^{20} H^{25} NO^{4}$; Codamine, $C^{20} H^{25} NO^{4}$; Papaverine, $C^{20} H^{21} NO^{4}$; Rhœadine, $C^{21} H^{21} NO^{6}$; Opianine, $C^{21} H^{21} NO^{7}$; Meconidine, $C^{21} H^{25} NO^{4}$; Cryptopine, $C^{21} H^{23} NO^{5}$; Laudanosine, $C^{21} H^{27} NO^{4}$; Narcotine, $C^{22} H^{23} NO^{7}$; Lanthopine, $C^{23} H^{25} NO^{4}$; Narceine, $C^{23} H^{29} NO^{9}$; Gnoscopine, $C^{34} H^{36} N^{2} O^{11}$. A bitter principle, Meconin, $C^{10} H^{10} O^{4}$, is also present in opium, accompanied by Meconic acid, $C^{7} H^{4} O^{7}$.

Porphyroxin, first described by Merck, occurs in East Indian, in Smyrna, and probably other opiums. The principle is of interest, because it has the property of being reddened by hydrochloric acid, a reaction which has been utilized for many years in testing for opium in medico-legal analysis in the Bengal Chemical Examiner's Department. In testing viscera for opium the ethereal extract obtained by Stas's process is evaporated in a porcelain capsule, and the dry residue moistened with dilute hydrochloric acid; on the application of a gentle heat a red coloration is developed should opium be present. A good plan of applying the test is to place on the bottom of the capsule containing the dry ether extract, a very small watch glass moistened with a few drops of concentrated hydrochloric acid, the capsule is then covered with a glass plate; after standing some time a red or violet reddish coloration appears on the sides of the capsule should porphyroxin be present. The application of heat is unnecessary when the test is applied in this manner.* The chemical composition of porphyroxin appears to be a matter of some uncertainty; according to O. Hesse it is a mixture of several distinct principles. Pedler and Warden isolated in 1886 from Bengal opium a neutral principle insoluble in water, but dissolving in ether, chloroform, benzol, &c., and yielding solutions which exhibited a magnificent blue fluorescence. The morphine in opium is combined with meconic acid. The nature of these two substances was made known by Sertürner in 1816, who at the same time pointed out the difference between morphia and narcotine, a substance which had been discovered in opium by Derosne in 1803 and also by Séguin. There can be no doubt that these two chemists also obtained morphine, but failed to distinguish it from narcotine. Warden *(Chem. News*, 38, 146,) has examined the ash of Behar opium. It was of a light grey colour and contained ·857 per cent. of charcoal, which was deducted before calculating the percentage composition, which is as follows:—$Fe^2 O^3$, 1·983; Ca O. 7·134; Mg O, 2·310; K^2 O, 37·240; Na^2 O, 1·700; SO^3 23·141; $P^2 O^5$, 10·902; Si O^2, 15·274. There were also traces of alumina, manganese, carbon dioxide and chlorine present.

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* It is necessary to note that this test is only employed as a corroborative one for the presence of opium.

The examinations of various kinds of Indian opium conducted by Dr. Buri in Prof. Flückiger's laboratory (*Pharm. Journ., April* 24, 1875,) gave the following results:—

	Patna garden opium, 1838.	Indian medical opium, 1852.	Abkari provision opium.	Garden Behar opium.	Malwa opium, flat cake.	Sind opium.	Hyderabad, Sind,	Khandesh.	Persian, 1872.
a—Ethereal extract, *i.e.* residue dried after the evaporation of the ether	24·2	21·7	22·0	20·6	14·1	17·4	20·4	...	25·0
b—Crude narcotine	10 0	9·0	8·5	7·6	7·6	8·0	9·7	...	10·2
c—Wax: difference between *a* & *b*	14·2	12·7	13·5	13 0	6 5	9·4	10 7	...	14·8
d—Purified narcotine	4·0	6·1	5 5	4·5	4·7	3·1	5·4	7·7	6·4
e—Crude morphine	11·2	11·2	14·1	10·6	14·4	...	...	...	...
f—Purified morphine	8·6	4 3	3·5	4·6	6·1	3·8	3·2	6·07	7·1

Professor Flückiger remarks:—

"The process for the estimation of narcotine and morphine was that described in the *Pharmacographia*, p. 59. The extract *a* of the above table is that afforded by means of boiling ether, with which the powdered opium had almost absolutely been exhausted by repeating the treatment with ether from about twenty to thirty times. The extract remaining after the evaporation of the ether was boiled with acetic acid, 1·04 sp. gr. This

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liquid, after the acid had been driven off, yielded *b*, crude narcotine, as a crystalline brownish mass. It was washed with ether, and then afforded *d*, purified narcotine. Under *c* the difference between *a* and *b*, representing the amount of waxy matter, is calculated. It includes also the oily matter, with which the Persian opium is impregnated, as well as a little wax in the case of sample I.

In exhausting the opium with ether, a slightly yellowish fluid is obtained, which displays a bluish fluorescence, due to an unknown constituent of the drug.

Before precipitating the morphine, the aqueous solution was concentrated in order to get a smaller volume.

“It afforded *e*, the crude, dried morphine, which, after twice or three times repeated recrystallization, finally furnished *f*, purified morphine. This purification of morphine cannot be performed without a loss of morphine; the real practical percentage of that alkaloid may therefore more correctly be regarded as somewhat superior to the figure *f*. It would be desirable to apply a process furnishing the exact percentage; yet there is, as far as I know, no such method thoroughly satisfactory. I have been struck with the very large discrepancy, in the Indian opium, of the figures under *e* and *f*, which, I think, is larger than in opium from Asia Minor. Another fact well worth considering is the usually low percentage of morphine of Indian opium, narcotine being frequently present to a larger amount. This has already been pointed out in the *Pharmacographia*, page 57. It would appear, however, that this is of no consequence for the Chinese consumption, yet, possibly, it will be so some day if the home production of the Chinese further increases. Perhaps a more careful preparation of the Indian opium would at least prove of importance, not so much with regard to the smokers of the drug as to the possibility of extracting morphine from Indian opium profitably. It is not needful to point out that this would be highly desirable.”

In the following table is shown the analysis of samples of Patna and Behar provision opium, Malwa opium and *pasewha*.* These analyses are interesting, as they indicate the amount of extractive obtained by the action of cold and hot water on the drug. The amount of extractive as well as the alkaloidal content varies within narrow limits from year to year. Analyses of Behar and Patna provision opium, arranged as shown in this table, are yearly placed before the merchants at the annual inspection of opium, which takes place before the first sale of the season:—

Variety of Opium.	Moisture at 100° C.	Cold-water extract on anhydrous opium at 100° C.	Hot water extract on anhydrous opium at 100° C	Narcotine on anhydrous opium.	Morphia on anhydrous opium.	Total alkaloids.
Behar cake No. 1, manufactured 26th May 1883	26·43	64·25	65·54	5·91	3·86	...
Benares cake No. 4, manufactured 1st January 1883	29·97	63·8	64·57	5·91	4·58	...
Malwa opium, 31st March 1883	8·56	65·90	68·58	6·81	4·92	11·73
Pasewha from Benares District, 1886	19 75	66·31	70·46	5·04	3·19	8·23
Pasewha from Benares District, 1888	22 00	72·05	76·16	4·10	·85	4·95

Regarding the amount of morphia in Malwa opium, according to Dr. Smyttan, formerly Opium Inspector, Bombay, the best Malwa opium yields 8 per cent., Flückiger's analysis gives 14·4 per cent. of crude and 6·1 per cent of purified morphia, a larger yield than that obtained by Mr. Gregory, who only found 4·92 per cent. On the other hand, while Flückiger found only 4·7 per cent of narcotine, the Opium Factory analysis affords 6·81 per cent. Flückiger's analysis of Patna garden opium, in which 8·6 per cent. is given on the content of purified morphia, is an exceptional yield of the alkaloid for

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* The analyses of Malwa opium and *pasewha* have been kindly furnished by Mr Gregory of the Benares Agency.

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Bengal opium. The analyses of *pasewha* are of special interest as indicating the very wide differences which may occur in its composition.

INDIAN MANUFACTURED ALKALOIDS.—We have examined morphia, codeine and narcotine manufactured at Ghazipore.

The morphia hydrochlorate was in white acicular prisms of silky lustre and free from odour. Dried at 100° C., the crystals lost 12·74 per cent. The hydrochlorate is usually stated to contain three molecules of water, which would be equal to 14·38 per cent. The chlorine calculated as H Cl. amounted to 9·42 per cent., the sample was consequently deficient in combined acid to the extent of ·3 per cent. The ash amounted to ·063 per cent. By the action of chloroform ·812 per cent. of extractive was obtained. The precise nature of this extractive was not determined; it probably contained a trace of morphia; it was tested specially for narcotine with negative results. Uncombined morphia to the extent of ·828 per cent. was detected in the sample.

The codeine was a perfectly white powder, and free from odour. Dried at 100° C., it lost 5·16 per cent. The ash amounted to ·056 per cent. The saturating power of the alkaloid for standard acid corresponded closely with that acquired by theory.

The narcotine was in faintly yellowish crystals. It contained only a minute trace of ash, and was free from morphia.*

The following statistics of opium-eating at Balasore, in Orissa, have been collected by Vincent Richards. He says:—"I estimate that about one in every twelve or fourteen of the adult population use the drug; but I believe the habit is somewhat increasing; this increase in the consumption of the drug dates from the famine year 1866, and is not the result of a growing abuse of it by individual consumers, but of a more

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* According to the late Surg.-Major Sheppard, in 1871 the cost of narcotine made at Ghazipore, including every charge, was 8 annas 11 pies per ounce, and the cost of morphia 3 annas per ounce.

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extended use of opium amongst the general population. There can be no doubt that opium-eating was greatly resorted to in the famine year, because it mitigated the sufferings arising from hunger and sickness, and enabled the poor people to exist on less food. The number of opium-eaters examined by me was 613, of whom 444 were men and 169 women; of the 444 men, 29 were between 15 and 25 years of age, 87 between 25 and 35 years, 165 between 35 and 45 years, and 163 above 45 years. Thus, by far the greater number were over 35 years of age. Of those above 45 years, 56 were between 45 and 50 years, 74 between 50 and 60 years, and 33 above 60 years. Of the 169 women, 10 were between 15 and 25 years of age, 33 were from 25 to 35 years, 47 from 35 to 45 years, and 79 were above 45 years of age. Here, also, the proportion of those above 35 years is greater. Many were over 50 years of age and not a few 60. It must be understood that the ages are not given as exact; they are, however, approximately correct, and arrived at after careful inspection and inquiry. These remarks apply equally to the following, though the periods are not likely to be very inaccurate, as they embrace such a number of years. Not a few mention the famine year (1866) as the time at which they first contracted the habit. Of the men, 274 are said to have taken the drug for from 3 to 10 years, 100 for from 10 to 20 years, 48 from 20 to 30 years, and 22 for more than 30 years. Of the women 104 for from 3 to 10 years, 43 for from 10 to 20 years, 14 from 20 to 30 years, and 8 for more than 30 years. The average ages at which the habit was commenced were amongst the men from 20 to 26 years, and amongst the women from 24 to 30 years. The majority of eaters take their opium twice daily, morning and evening, but not a few in the evening only. Much depends upon the dose, and whether the person has been long addicted to the habit. The well-to-do people mix the drug with water and strain before drinking, but poor people swallow it just as it is sold by the opium vendor. The quantity taken varies from 2 grains to 45 or more daily; but as I shall show large doses are quite the exception, especially amongst

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the poorer classes. Of the 444 men, 266 took from 2 to 4 grains daily, 151 from 4 to 12 grains, 18 from 12 to 16 grains, and only 9 more than 16 grains—average 7 grains. Of the 169 women 132 took from 2 to 4 grains, 33 from 4 to 12 grains, and 4 only from 12 to 16 grains; not one took more than 16 grains—average 5 grains. The dose when large has always been gradually increased from the beginning; but it is not at all unusual to find, when the dose is small, that there has been no increase at all. There is not, therefore, that craving for increasing doses, which is generally supposed to exist, nor do the 5 or 7 grains as sold by the vendors represent the actual amount of pure drug, as it is not unfrequently adulterated with catechu and other substances. I think it must be conceded that the foregoing data prove conclusively that excessive use of opium amongst the agricultural classes, and they are the chief consumers in Orissa, is very rare indeed, and that its moderate use may be, and is indulged in for years without producing any decided or appreciable ill effects, except perhaps one to which I shall allude hereafter, though it is a question whether the fact is not rather a blessing from a humanitarian point of view, when we consider how prone destructive agents, such as war, famine, and pestilence are to begin their work of destruction immediately the increase of population proceeds too rapidly." As to the causes which first lead to the use of the drug, they may be summed up as follows:—" Sickness, example, and a belief in its aphrodisiacal powers. The majority are induced to begin the habit through disease, such as fever, elephantiasis, dysentery, colic, rheumatism, and diarrhœa. Some few asserted that they took the drug to enable them the better to undergo fatigue, and to make long journeys. There is one almost inevitable result of a prolonged indulgence in opium-eating, especially if immoderate, namely, a weakening of the procreative powers; in no fewer than 99 cases out of 125 into which I particularly enquired with a view to ascertaining the fact, was this the case; moreover, of the 125 married men, averaging 36 years of age, the average number of children to each was 1·11 after eleven years of married life. The average dose taken by these men was 14 grs. per diem, and the length of time they had been addicted to the habit 12 years. Opium-eating, at any rate in Balasore, does not conduce to either crime or insanity, since the inhabitants are a particularly law-abiding race, and the insanes are only 0·0069 per cent. of the population."—(*Indian Medical Gazette*, Vol. XII., No. 9, August 1st, 1877.) Our experience of opium-eating in India, though not supported by statistics, leads us to form the same opinion as Vincent Richards with regard to the moderate use of the drug. We believe that excessive indulgence in it is confined to a comparatively small number of people amongst the well-to-do and wealthy classes of the community. More recently (1881), Dr. Moore has published his experience of opium-eating in Rajputana, which supports strongly Richards' opinion.

Opium and all its alkaloids act almost exclusively on the central nervous system, and in mammals especially on the brain, the brain symptoms preponderating in proportion as the organ is developed relatively to the other nerve centres. When taken in small doses there is first a stage of excitement of the circulation, as evidenced by the pulse being fuller and quicker, and by the surface of the skin being warm and flushed. During this stage the individual has the power of directing his energies to any particular object, and the action of the drug causes him to do well whatever he wishes to do. Thus, if he wishes to sleep, and surrounding circumstances be favorable, an agreeable languor followed by quiet sleep comes on. He can be easily aroused from this sleep, and after a few hours the effect passes off, leaving, however, slight headache and languor, with dryness of mouth and slight nausea. If, on the other hand, he wishes to work, he can do this with increased energy; or, if he desires to exert the mind, he will find his imagination more vivid, his thoughts more brilliant, and his power of expression greater. (*Christison.*) With moderate doses the stage of excitement is short and is followed by deep sleep, from which the person can still be aroused. The after-effects

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are severe headache, with nausea, furred tongue, and loss of appetite. During the stage of sleep the brain is anæmic, both the arteries and veins being empty. With large doses the first stage is very short. Sleep rapidly follows, becoming deeper and deeper, and passes into coma, from which the patient can no longer be aroused. The pupils become very much contracted, and the pulse from slow and full, becomes feeble. Finally death by asphyxia occurs, the respiration ceasing before the heart. It may occasionally be preceded by convulsions, though this is rare. Upon *post-mortem* examination the ordinary appearances of death by asphyxia are found. (*Lauder Brunton.*)

Although the symptoms which have been narrated are those usually produced by opium, yet in certain individuals the drug provokes quite different phenomena. One of the most common is an excessive depression following the sleep produced by moderate doses. The symptoms are a feeling of weakness and prostration, often accompanied by chilliness, dull headache, and giddiness, but especially marked by intense nausea and frequent vomiting. In some cases this condition of depression even replaces the normal second stage. A second and rarer idiosyncrasy towards opium exists in those persons who are rendered by it very delirious, it may be, even wildly so. In certain cases of opium poisoning, convulsions, either partial or complete, have occurred amidst the more usual phenomena. (*Wood.*) In childhood opium is badly borne owing to the preponderance of the brain over the rest of the body and the rapidity with which absorption takes place. Habit enables opium-eaters to take large quantities without danger to life, and in such persons the effects of the drug are very slowly produced, probably owing to a torpid condition of the intestines induced by the habit. Lauder Bruuton suggests that the morphine of one dose may be converted in the organism into oxydimorphine, and thus exert an antagonistic action to the next dose. It has been stated that native opium-eaters eat large quantities of sweetmeats to counteract the effects of the drug.

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Persons suffering from great pain will bear very large doses of opium; on the other hand, in any disease which interferes with excretion opium requires to be given with great caution.

Of the opium alkaloids morphia is almost purely narcotic. Codeine has a feebly narcotic action, but it greatly lessens the irritability of the nerves of the viscera, both thoracic and abdominal, whence its value in cough and diabetes. Narcotine is nearly related to codeine in its action, and has been largely used in India as an antiperiodic in doses of from 3 to 6 grains. Thebaine approaches strychnia in its action and is an active poison.

In connection with the effects of opium on the system, it is interesting to note that at the Government Opium Factories at Patna and Ghazipore, although men may be immersed above their knees for several hours daily in semi-liquid opium, as in the preparation of *lewa*, that no symptoms of the action of the drug on the system appear to ensue. Again, during the manufacture of opium into cakes for the China market, each cake-maker has as an assistant a boy of from 6 to 12 years of age. By the end of the day's work these children are literally smeared from head to foot with *lewa*, and although the special intolerance of children to opium is well established, cases of toxic symptoms ensuing appear to be unknown. In Patna, and probably also in the Ghazipore district, there is a belief that opium cake-makers are especially exempt from cholera. In certain instances the effects of constantly residing at a sudder opium factory appear to induce a torpid condition of the liver, leading to sub-acute congestion.

Note on Poppy Petals.—The use of poppy petals in the manufacture of the shell of the provision opium cakes has been already referred to; Mr Scott* states that the annual consumption of poppy petals is upwards of 16,000 maunds, for which supply the entire petals of no less than 4,710,400,000 flowers are required. During 1869-70, the sum of £10,235 was spent by Government for the purchase of leaves (made from petals) for one Opium Agency. The ash yielded by Behar poppy petals has been examined by Warden*; after deduction of carbonic anhydride, sand and charcoal, its composition was as follows:—

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* "*Manual of Opium Husbandry.*"

Ferric oxide, 3·86; Aluminic oxide, 1·22; Magnesic oxide, 5·60; Calcic oxide, 10·72; Potassic oxide, 41·75; Potassic chloride, 12·28; Sodic chloride, 1·20; Sulphuric anhydride, 3·85; Phosphoric anhydride, 5·61; Silicic anhydride, 13·86.

The capsules and seeds of the poppy are prescribed by native doctors in diarrhœa; the former retain a small quantity of opium. From the seeds is made the Sharáb-i-kashkásh of the Mahometan physicians.†

The Malwa poppy capsules have been analysed by Lyon, of Bombay (1879), who obtained from them ·099 per cent. of alkaloids soluble in ether, consisting apparently of narcotine, ·023 per cent. of impure alkaloids soluble in benzol, and ·033 of impure alkaloids soluble in chloroform. No morphia could be detected in them by the ordinary reagents.

Toxicology.—Opium is chiefly used in India for suicide and infanticide. It is a common practice to swallow oil after the opium, and this is stated to be done by the most determined suicides, who knowing that an attempt will be made to recover them by treatment, have made up their minds to render it fruitless. The belief is that the oil unites with the opium and makes it adhere to the stomach in spite of emetics. Dr. Center remarks that it is possible that the oil might act as a mild laxative which would carry the poison more rapidly from the stomach into the intestines, out of the reach of emetics; while its absorption would go on as well in the latter as in the

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* *Chemical News*, xxxix., No. 999.

† Take half a maund of poppy seeds, soak them for twenty-four hours in four maunds of water, then bruise the seeds, replace them in the same water and boil down to one-half, rub on a strainer, and add one maund of sugar to the fluid obtained. Compare with Scrib. Comp. 73.

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former. The quantity of oil taken is often enormous. Opium is also the favourite poison for infanticide. Generally a small quantity is smeared on the nipple and the child allowed to suck. For murder opium is rarely used. During the last ten years only one case has been observed in Bengal and one in the Punjab.

In Bengal the percentage of poisoning by opium in 1880-81, was 35·9 in 270 viscera examined; in 1881-82, 22·6 in 210; in 1882-83, 25·0 in 210; in the remaining nine months of 1883, 19·7 in 126; in 1884, 22·5 in 217; in 1885, 21·3 in 234; in 1886, 19·5 in 266; in 1887, 24·0 in 233.

In the Punjab the percentage was in 1879, 1·8 in 162 viscera examined; in 1880, 0·5 in 194; in 1881, *nil* in 186; in 1882, 1·9 in 201; in 1883, *nil* in 194; in 1884, *nil* in 200; in 1885, *nil* in 234; in 1886, 0·35 in 272; in 1887, *nil* in 228.

In the North-West Provinces and Oudh it is impossible from an examination of the Annual Reports to ascertain the number of human viscera examined during any one year, all the references being classed as "cases," but for the reasons already given, we may assume in the case of opium, that the detections were made in human viscera. The record shows in 1879, 18 detections in 156 cases; in 1880, 18 in 173; in 1881, 18 in 158; in 1882, 19 in 156; in 1883, 12·9 in 177; in 1884, 11·2 in 182; in 1885, 10·7 in 186; in 1886, 8·2 in 170; in 1887, 11·6 in 171.

In the Madras Chemical Examiner's reports we find under the head of "Human Cases, Class A, Viscera examined," that in 1882 opium was detected in 7 out of 152 cases; in 1883, in 9 out of 123 cases; in 1884, in 4 out of 85 cases; in 1885, in 6* out of 81 cases; in 1886, in 2 out of 84 cases; and in 1887, in 1 out of 76 cases. Under the head of "Suspected Attempts to Poison" no detections were made in the articles examined in 1882 and 1883; in 1884, one detection was made in 50 examinations; in 1885, two in 47 examinations; in 1886, four in 47 examinations; and in 1887 none.

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* Of these two were morphia.

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From the Bombay Chemical Examiner's reports it appears that during the five years ending the 31st of December 1887, the total number of deaths of human beings from poison reported to his office was 225, of which 66 or 29·3 per cent. were from opium. If, however, we take the ten years ending the 31st of December 1887, the figures are—Total deaths 467, of which 98 or 21 per cent. were from opium. The following table gives an analysis of the Bombay cases for the last ten years:—

	Fatal Cases.							Non-Fatal Cases.	Total Cases.
	Children.	Adults.		Total deaths.	Suicide and unknown.	Accident.	Homicide.		
		M.	F.						
1878-79 ……	…	1	5	6	6	…	…	1[1]	7
1879-80 ……	1	5	4	10	8	2[2]	…	…	10
1880-81 .. …	…	5	1	6	6	…	..	1	7
1881-82 ……	…	3	6	9	9	…	…	1[3]	10
1882-83 ……	…	…	1	1	1	…	…	1[4]	2
1883…………	3	7	5	15	12	3[5]	…	2[6]	17
1884…………	1	3	5	9	8	1[7]	…	…	9
1885…………	…	9	9	18	18	…	…	2[8]	20
1886 ………	2[9]	5	4	11	10	…	1	1	12
1887…………	…	7	6	13	13	…	…	1[10]	14
	7	45	46	98	91	6	1	10	108

[1] Detected in a paste on the end of an abortion stick.

[2] One of these in a child aged 2 years. The other a male adult from an overdose of Hydrochlorate of Morphia injected hypodermically.

[3] An attempt at suicide.

[4] In vomit of a man; supposed to have been administered to him in sweetmeat with what motive not stated.

[5] All three children, one clearly accidental, the other two doubtful.

[6] Both attempts at suicide by females.

[7] A boy aged 7 from drinking Kasumba.

[8] In one of these in sweetmeat; in the other opium forwarded for identification. History of case not given.

[9] One of these a case of suicide in a girl aged 13; the other apparently a case of homicide of an infant 2 months old.

[10] Liquor drugged with opium administered by a man to a woman; intent doubtful.

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Commerce.—Purchase by Government. All opium is now received by Government on the *challán* or pass system, the *assamiwár,* which we have noticed above, having been abolished. On receipt at the factory it is submitted to examination.

The points that an Opium Examiner keeps before him, and that intuitively pass through his mind, in the physical examination of the drug are:—

(*a*) consistence,
(*b*) colour,
(*c*) texture,
(*d*) aroma.

Each one of the above points gives him some indication as to the quality of the drug and its ultimate appraisement, and also to its disposal for factory uses.

Consistence.—By this term we mean the actual percentage of solid and non-volatile matter in any given sample of the drug, if it were subjected to evaporation and reduced to dryness at a temperature of 200° Fahr.

Pure opium being paid for by Government at a fixed rate for a certain standard of consistence, and being subject to a *pro rata* increase or decrease in price according as it is above or below that standard, it will be readily seen that the importance of arriving at the true consistence of any given parcel of the drug stands second to none of the many duties devolving on the Opium Examiner.

By the help of sensitive balances and metallic tables heated by steam, accurate results in the estimation of consistence can be relied on, and the mechanical method pursued at the present day has already been noticed. Such a delicate operation, however, as the "assaying" of opium, (as the estimation of the true consistence by steam tables is termed), can be

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applied to a very limited portion of the many thousand tons of the drug that pass through the factories. Every 100 grains of the drug, therefore, that is placed on the steam table is a representative sample of a large bulk that has been adjudged of nearly equal consistence by the remarkable power of hand estimation practised at the factories, a power that is gained only by years of experience in the examination of the drug.

It would be difficult therefore—nay impossible—to lay down rules for arriving at results that can be satisfactorily obtained only by practice. A few guiding principles will, however, be touched on here.

As a rule the consistence of opium freshly collected from the capsule varies considerably, according to peculiarities of soil and weather, ranging from 30° to 50°, that is, it contains from 30 to 50 per cent. of solid matter.

Between the time of collection, and of weighment and examination of the drug at the Government scales there is generally an interval of from one to even three months, and during this period it is within the power of the cultivator so to manipulate his drug as to raise it to any standard of spissitude. Experience, however, shows that the cultivator is not so easily schooled into turning out an article exactly suitable to the requirements of our factories, and it is no uncommon thing to find in one season two jars lying side by side, one of which contains opium yielding a clean section if cut with a spatula, the other containing a drug so fluid as to be poured out of the jar by tilting it over.

The practical impossibility of guessing with certainty to a degree the consistence of any given sample of opium has given rise to the "classes" of opium now obtaining at the two Agencies. Each class includes in it a range of three degrees of consistence, and between the first and the last class is included all the opium that is ordinarily brought to the Government scales.

The following is the classification table adopted for good opium at the two factories at Patna and Ghazipur, together with the distinctive mark of each class :—

Class.	Distinctive Mark.		Degrees included in each Class.
	At Patna.	At Ghazipur.	
Báshi bála darawal	$\overline{\overline{\text{X}}}$	XXX	79, 80, 81
Bála darawal	$\overline{\text{X}}$	XX	76, 77, 78
Darawal	X	X	73, 74, 75
Awal	I	I	70, 71, 72
Duyum	II	II	67, 68, 69
Siyum	III	III	64, 65, 66
Chaharum	...	IV	61, 62, 63
Panjum	...	V	58, 59, 60
Shishum	...	VI	55, 56, 57
Haftum	...	VII	52, 53, 54

For purposes of district classification the above table answers admirably, and it is also adhered to at the factories when re-classifying by touch the classification of district officers, prior to the ultimate appraisement of the opium by the help of steam tables. During this final classification, however, when the object at the factories is to arrive at the true consistence of every parcel of opium, drug of a spissitude estimated by touch to be above the highest or below the lowest class is assayed separately on the steam table, and its true consistence adjudged.

We have thus seen that there are two methods practised at the Agencies for estimating consistence, (*a*) by steam tables, (*b*) by touch. The second is a rough and ready method of assigning into one class masses of opium the true

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average consistence of which is finally settled by the first method.

For the determination of consistence which is dependent only on the quantity of moisture contained in the drug the mode of procedure is a simple one and the results satisfactory. In practice, however, disturbing elements are very often introduced, and one of these is *pasewha*. Opium with an admixture of *pasewha* is deceptive to the touch.

In drug free from *pasewha* the granular texture appears to maintain cohesion between the particles which, as it were, support each other and offer a certain amount of resistance to pressure. In drug with a copious admixture of *pasewha* the granular texture is destroyed by the gradual merging of the tears into each other through the medium of the tenaceous and shiny *pasewha*, the cohesion existing is thus lessened, but the tenacity of the drug is increased.

Where the bulk of the produce at the factories lies somewhere intermediate, with regard to the admixture of *pasewha* between the two descriptions of drug given above, the sense of touch is regulated by what comes most in its way. When dealing, therefore, with varieties bordering on the two extremes of the drug we are apt to go astray, and we are thus able to account in a large number of cases for what is known as being "out in parakh" (judgment). We have thus prepared for ourselves an arbitrary and indefinable standard of "touch;" it is, nevertheless, a standard so generally accepted by all examiners of opium in the Agencies that it is practically a fixed one, and it is a recognised maxim that opium entirely free from *pasewha* will assay lower than this our accepted standard of touch, and that opium with a copious admixture of that substance will assay correspondingly higher. A good "parkhia" (examiner) will always, therefore, make due allowance for the absence or presence of *pasewha* in any sample of the drug that is being subjected to examination for consistence. The remarks made here refer entirely to good opium.

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Another disturbing element in estimating consistence is heat, particularly on drug charged with *pasewha*. Drug of this character under the influence of heat, undergoes liquefaction to a moderate extent in the process of drying. Opium to be examined for consistence by touch, should invariably be placed, therefore, in shaded and cool verandahs, and the examination should be concluded by 9 or 10 o'clock in the morning, and before the sun gets hot. When, for want of accommodation, jars have to be placed in open yards, their examination should invariably be undertaken first, and in the early morning. The examination by touch, for consistence, of opium that is lying exposed to the sun's rays in the months of April, May, June and July, when all the examination at the factories is conducted, must always be faulty and conjectural, and should never be attempted.

Colour.—The natural colour of the drug runs through infinite shades of brown, from a dull or even bright chestnut to a reddish-brown, and from a dark mahogany to a blackish brown. It even appears black at times when viewed in bulk.

These variations are due to causes with which we have no concern here, suffice it to say that they are natural, and to a practised eye easily discernible as the true colours of opium. Age and exposure may darken the colour of the drug but cannot alter its characteristics; and where an alteration appears it may be accepted as a sure indication of adulteration or sophistication of some sort, although, again, sophistication of the drug is possible without any perceptible alteration of colour.

The true colour of opium is clearly seen when the drug is viewed in a very thin film; this is best accomplished by pressing a small portion between two glass slips against the light, or by rubbing it down with the finger on a white earthenware plate. Here it is that we see clearly the various shades of chestnut, reddish brown, dark brown or mahogany, but never black. When rubbed between the fingers opium displays a shining surface and a waxy lustre.

The colour of opium is a valuable indication as to its purity.

Texture.—Like consistence and colour the drug delivered at the Government Factories may be said to differ, one sample from another, in texture. At the two extreme poles of variation there are the distinctly granular, and the perfectly homogeneous, and the bulk of the produce lies, as to texture, somewhere intermediate between those extremes.

The primary causes of variation, into which our enquiry does not extend, are undoubtedly due to differences in soil, and to conditions of weather obtaining at the time of collecting the drug; they are also due, to some extent, to manipulation of the drug after collection. A light-coloured, chestnut or reddish-brown variety of the drug, which is free from *pasewha*, will, as a rule, be found to be distinctly granular, while the dark, or blackish-brown variety, which has more or less of *pasewha* in its composition, or an excess of moisture, will on the other hand tend to the homogeneous type.

Ordinary manipulation, without the aid of sophistication, has little effect on texture, but long-continued manipulation will affect it materially. The presence of *pasewha*, again, affects it in a very marked degree, and so does an excess of moisture.

As already explained under the head "consistence," to the presence of *pasewha* in varying quantities is due the merging, more or less, of the tears into each other whereby the granular nature of the drug passes by imperceptible gradations to the homogeneous. The presence of *pasewha* also alters the dull waxy appearance of the drug to one that is more or less smooth and shiny, adding to it tenacity, and making it more glutinous. Ordinarily, opium, free from *pasewha*, is moderately ductile, but the presence of *pasewha*, by adding tenacity, increases also the ductility of the drug. This is seen by drawing out with both hands opium of high consistence. If free from *pasewha* it will be found to be ductile to an extent varying according to consistence, with a uniform and minutely granular texture. When there is *pasewha* present this ductility is increased, while the granular texture is less marked, according

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to the proportion of *pasewha* present. The drug when thus drawn out breaks with an irregular fracture; it adheres to the fingers, is viscid and of a plastic nature. The texture of the drug is also well seen in high consistence opium when a section is exposed with a spatula.

Opium of the lower consistences—below about 60°—being in a somewhat fluid state, will not draw out at all but breaks off with ragged edges. Its texture is subject to change, under the same conditions, as in opium of higher consistences.

The texture of any given sample of pure drug is always uniform. A practised eye can at once detect any irregularity, and where such exists it betrays the presence of a foreign substance in the composition of the drug.

Aroma.—Chemistry has not yet isolated the volatile odorous principles of opium. Its aroma, however, is peculiar and characteristic. Some consider it not unpleasant, while others relegate it to the class of disagreeable odours. In well-prepared, fresh drug the aroma is decidedly fruity, but it varies with age, and is even said to vary somewhat with the description of soil on which the plant is grown, and with the manure used.

Careless preparation of the drug, such as its collection or manipulation in plates not scrupulously clean, or allowing it to come in contact with animal substances, such as bladders for storing it away in, or keeping it in ill-ventilated and smoky closets, or shutting it up for security in small, close receptacles, will dissipate and destroy the aroma in drug that is otherwise intrinsically good, and will even give it an offensive odour.

The aroma of the drug is one of its chief commercial criterions, and as such should be carefully guarded by the cultivator. To the Opium Examiner it gives a very important indication as to the suitability of the drug for the various Factory purposes. It is only by chemical tests that the Examiner can be certain that opium that is devoid of aroma or offensive to the smell, although apparently good as to texture and colour, has not also a foreign substance in its composition.

assuming that the foreign substance, if present, has not given the clue by its own specific odour. Under any circumstances, opium deteriorated in its aroma, although it may be otherwise pure, should be set aside, and utilised for other than the main Factory purpose, that is, amalgamation with drug intended for the central mass of cakes, otherwise there will be risk of the deteriorated drug tainting a much larger mass of good opium. (*Gregory.*)

Export.—India exported in 1886, 121,000 cwts. of opium, valued at 1,073 lacs of rupees; in 1887, 132,000 cwts., valued at 1,108 lacs; in 1888, 126,000 cwts., valued at 1,007 lacs.

PAPAVER RHŒAS, *Linn.*

Fig.—*Eng. Bot.* 645; *Bentl. and Trim., t.* 19. Corn Poppy (*Eng.*), Coquelicot (*Fr.*)

Hab.—A weed of cultivation. The capsules.

Vernacular.—Jangli-mudrika (*Bomb.*), Lálá (*Guz., Hind.*).

History, Uses, &c.—There is little to be found in Indian works about this poppy. It is the ροιάς of Theophrastus and probably the μήκων ροιάς of Dioscorides.* The Khash-khásh-i-Mansúr of the Arabs and Persians may possibly be the same plant; it is described by them as hairy, leaves much divided, capsules small; called Mansur, because it sheds its petals very quickly. In Guzerat and Northern India *P. Rhœas* is grown in gardens, and is called Lálá by the Mahometans, who suppose it to be the Lálá of the Persian poets. The name Mudrika given to the capsules means "stamped with the Mudra or Seal," which is used by Hindus after bathing; and which resembles the capsule in shape. This seal is impressed upon the forehead, both temples, both breasts, both shoulders and the pit of the stomach; that used by the followers of Vishnu is inscribed with the words, "*Shri Narayen,*" and is dipped in Gopichandan, a kind of white clay, and that used by the followers of Shiva bears the word "*Namás Shevaya,*" and is dipped in Bhasam (ashes of cowdung). Some of the Swamis, or religious teachers, use a red-hot Mudra to stamp their disciples with. The milky juice of the capsules has a narcotic odour, and slightly sedative properties. Theophrastus says that the herb has the taste of wild endive, and Fée remarks that the peasants of Treves eat the leaves when young.

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* Theoph. Hist. Plant. ix. 13; Dios. iv. 62. Pliny also mentions the Rhœas or wild poppy, 20, 77; 21, 94.

Description—The capsules are distinguished by their smooth globular form, those of *P. dubium* being twice as long as broad, and those of *P. hybridum* being bristly.

Chemical composition.—Hesse has obtained from the milky juice a colourless crystallizable substance, Rhœadine, $C^{21} H^{21} NO^{6}$, of weak alkaline reaction. It is tasteless, not poisonous, nearly insoluble in water, alcohol, ether, chloroform, benzol or aqueous ammonia, but soluble in weak acids; its solution in dilute sulphuric or hydrochloric acid acquires, after a time, a splendid red colour, destroyed by an alkali; but reappearing on addition of an acid. Owing to a statement made by Selmi that the capsules contain an alkaloid similar to morphia, Hesse has again examined them. He says:—"The juice collected in the morning under a clouded sky gave 35 per cent. of dried residue at 100°. The milky juice is at first mostly white; sometimes citron yellow; ferric chloride produces with it a deep red colour, which probably indicates the presence of meconic acid. 4·4 grammes of dry residue gave no trace of morphia, or of a similar alkaloid, 0·090 gramme gave equal to 2·1 per cent. of Rhœadine, and traces of another alkaloid. Rhœadine is not coloured by ferric chloride, but resembles morphia in being almost insoluble in ether." (*Liebig, annalen d. chemie, Vol. clxxv., p.* 329.) Attfield, working on a large quantity of material, and by three different processes, failed to detect a trace of morphia in the petals. (*Pharm. Journ.* (3), *Vol.* 4, *p.* 290.)

ARGEMONE MEXICANA, *Linn.*

Fig.—*Bot. Mag., t.* 243; *Wight, Ill. ii., t.* 11. Gamboge Thistle, Mexican Poppy (*Eng.*), Pavot épineux, Chardon bénit (*Fr.*).

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Hab.—America. Naturalized in India. The juice of fresh plant, and oil of the seeds.

Vernacular.—Bharbhand, Kutaila or Kutila (*Hind.*), Shiálkantá (*Beng.*), Datturi (*Can.*), Birama-dandu (*Tam.*), Bramha-dandi-chettu (*Tel.*), Daruri (*Mar.*).

History, Uses, &c.—This is an American plant which has now run wild all over India; it may easily be known by its glaucous prickly thistle-like leaves, bright yellow flowers and yellow milky juice. The latter is used by the natives as an application to ulcers, and in combination with the juice of *Aristolochia bracteata* is given internally in syphilis and gonorrhœa. (*Hové, Tours* in 1787-88; *Bomb. Govt. Records No* 16, *New Series.*) In the Concan the juice with milk is given in leprosy. The seeds and seed oil have been used by European physicians in India, and there has been much difference of opinion regarding their properties, some considering them inert, and others asserting that the oil in doses of from 30 to 60 minims is a valuable remedy in dysentery and other affections of the intestinal canal. The evidence collected in India for the preparation of the Indian Pharmacopœia strongly supports the latter opinion; our experience is also in favour of it; and Charbonnier, who examined the oil in 1868, found it aperient in small doses; possibly those who have used the oil unsuccessfully purchased it in the bazaar, and were supplied with a mixed article; no bazaar-made oils can be relied upon. Further experiments with the oil fully confirm this opinion. Flückiger found 4 to 5 grammes to have a mild purgative effect. The smallness of the dose required to produce an aperient action, and the absence of any disagreeable taste, will probably lead to a more extended use of it as a substitute for castor-oil. An extract made from the whole plant has been found to have an aperient action, and the milky juice to promote the healing of indolent ulcers. We have not noticed any bad effects from its application to the eyes. Its use as an external application to the eyelids in conjunctivitis was probably introduced into this country with the plant by the Portuguese, who appear to

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have adopted it in Brazil as a substitute for the Argemone of the Greeks and Romans (*Papaver Argemone*) which was used for that purpose.*

For a similar account of the properties of this plant, as observed in the West Indies by Hamilton, see *Pharmaceutical Journal* [i.], *Vol. IV., p.* 167.

Pouppé Desportes of St. Domingo describes the fresh seeds as emetic and slightly narcotic; he states that the oil obtained from them is used to relieve pain in dry colic.

Description.—The capsules are ¾ to 1½ inch long, terete, bristly, elliptic or oblong, and contain a number of dark brown rugose seeds, rather larger than black mustard. The oil has a bland nutty flavour; when first expressed it is sherry coloured, but becomes, after having been kept for some time, reddish brown.

Chemical composition.—The extract of the whole plant was examined by Haines (1863), who was unable to find any alkaloid in it. Charbonnier (1868) found a small quantity of morphia (?) in the leaves and capsules. The seeds contain in one hundred parts, 36 of oil, 49 of carbohydrates and albumen, 9 of moisture, and 6 of ash. The oil is of a light orange yellow colour and is almost tasteless, it has a specific gravity of about ·920, and remains clear at —8° C.; it dries slowly to a firm jelly, gaining during the process over 8 per cent. of its weight, and then ceases to give the red colour with nitric acid; it is only very slightly soluble in alcohol. The insoluble fatty acids amount to 90 per cent., and melt at 22° C. O. Frolich (1871) obtained from the oil a pretty hard soda soap, and found in the soap liquor, butyric, valerianic, acetic, and a little benzoic acid. According to Flückiger (1871) the oil has the specific gravity of ·919 at 16·5 C., remains clear at —·6 C., dries slowly and incompletely, and is not soluble in 6 volumes of 90 per cent. alcohol, as stated by Charbonnier. Dragendorff has found that the seeds contain an alkaloid which can be isolated in precisely the same way as morphia, and which agrees with it in all important reactions. As the alkaloid occurs in a very small amount, a sufficient quantity has never been prepared for ultimate analysis. The ash of the seeds is largely composed of alkaline phosphates and sulphates.

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* Dios. ii., 168, 169. Apul. Platonicus de Vir. Herb. 32.

Toxicology.—In 1878, a case occurred in Bombay in which a number of people suffered from vomiting and purging after using sweet oil which had been adulterated with Argemone oil. The adulteration may be detected by the rich orange red colour developed when strong nitric acid is added to the oil or to mixtures containing it. In the same year samples of oil were received by the Punjab Chemical Analyser from Amritsar, Simla and other towns which were said to possess irritant properties, causing purging and vomiting. The oil was stated to have been imported from the N.-W. Provinces and to have been made from Siyál-kánta (*Argemone mexicana*).

Commerce.—Occasionally large parcels of the seed are offered for sale, but they are not easily placed, as the oil burns with a very smoky flame.

MECONOPSIS WALLICHII, *Hook.*

Fig.—*Bot. Mag., t.* 4668.

Hab.—Temperate Himalaya.

Description.—*Meconopsis aculeata, Royle, Ill.* 67, t. 15; *Hook. Bot. Mag., t.* 5456, and *M. nepalensis, Dc.*, are reputed to be narcotic, but as O'Shaughnessy gave a drachm of the alcoholic extract of the former plant to a dog without producing any effect, it cannot have very active properties. *M. Wallichii* has been examined by us; it is a large herbaceous plant with tapering roots 6 inches long or more, sometimes bifurcated, 1½ inch or more in diameter, nearly smooth below, but at the upper part very scaly from the remains of leaves round the origin

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of the flower stem, which is about 1 inch in diameter and hollow; between the scales are stiff yellow bristles. The root is brown externally, internally white, soft and spongy, with a large central pith. Odour somewhat musky.

Chemical composition.—The root dried by exposure to air, and reduced to a fine powder, lost 8 per cent. of moisture at 100° C. The ash amounted to 12·7 per cent., and contained a marked amount of manganese. The alkalinity calculated as K H O, after separation of lime, was equal to 8·6 per cent. Digested with light petroleum ether ·48 per cent. of a pale yellow, viscid, transparent, odourless extract was obtained. With the exception of a few white flocks the extract was soluble in absolute alcohol. On spontaneous evaporation shining laminæ separated, which under the microscope consisted of rhombic plates and needles: oil globules were also visible. The alcoholic solution of the extract was strongly acid. The amount of crystalline matter was too small to admit of the nature of the fat acid being determined. After exhaustion with light petroleum ether, the powder was dried by exposure to air, and then digested with ether. On evaporating off the ether, ·41 per cent. of a fragrant, soft, indistinctly crystalline residue was left. The extract was heated with dilute hydrochloric acid, and the soft, yellow, insoluble residue separated by filtration. The acid solution was rendered alkaline with ammonia, and then agitated with ether. On separation of the ether only a minute trace of residue was left, which did not respond to alkaloidal reagents. The yellow residue insoluble in H Cl. was treated with ammonia, and the turbid mixture agitated with ether. The ether left on evaporation a yellow, soft, non-crystalline residue, without taste or odour; which had the properties of a neutral resin. The aqueous alkaline solution after the separation of the ether, yielded yellow flocks when treated with dilute acids, which were re-dissolved by alkalies: this principle had the properties of a resin acid. The fragrant odour of the ethereal extract was probably due to a trace of benzoic acid.

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After treatment with ether the powder was again dried, and then digested with absolute alcohol. The alcoholic solution was of a pale greenish colour, and possessed a marked greenish-yellow fluorescence; examined spectroscopically no absorption bands were visible. On evaporation, the alcoholic solution yielded 1·07 per cent. of extractive, yellow in colour, and possessing a somewhat fragrant odour. The extract was partly soluble in water. The aqueous solution did not possess any particular taste; it yielded slight precipitates with alkaloidal reagents; with ferric chloride no coloration was produced. On evaporation and ignition a trace of ash was left, possessing an alkaline reaction. The portion of the alcoholic extract insoluble in water, dissolved in alcohol, yielding a greenish solution, with acid reaction, and greenish-yellow fluorescence. The powder, after treatment with alcohol, yielded 12·6 per cent. of extractive to cold water. The aqueous solution was yellowish-brown in colour; alkaline in reaction; it afforded no coloration with ferric chloride; it slightly reduced an alkaline solution of copper on boiling.

FUMARIACEÆ.

FUMARIA OFFICINALIS, *Linn.*

Fig.—*Eng. Bot.*, 589. Common Fumitory (*Eng.*), Fumeterre officinale (*Fr.*).

Hab.—Persia, a weed of cultivation.

Vernacular.—Sháhterah (*Pers.*), Pitpápra, Sháhtera (*Hind.*, *Beng.*, *Bomb.*).

History, Uses, &c.—The Pitpápra imported from Persia does not appear to be *Fumaria parviflora*, as it has a smooth fruit without a double pit at the apex; it is doubtless *F. officinalis*. Several species of Fumitory have long been used medicinally, and were highly esteemed by the Greeks and Romans on account of their diuretic and alterative

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properties. Dioscorides calls the plant Kápnos,* and Pliny derives the name Fumaria from Fumus, smoke, with the explanation that the plant irritates the eyes like smoke; it has also been called *Fumus terræ* with reference to the colour of the foliage, or its smell. Fumitory does not appear to have been mentioned by the early Sanskrit writers. The Arabians and Persians probably derived their knowledge of it from the Greeks, as they hold the same high estimate of its properties. In the Makhzan-el-Adwiya two varieties are mentioned, one with violet-coloured flowers, and a large kind with white flowers; it is described as diuretic and alterative, removing hepatic obstructions, aperient and expellant of the humors, but more especially of atrabilis; two Greek names are given, Kiasúsi and Káfnús; the Arabic names are Baklat-el-malik, and Shahteraj, a corruption from the Persian Shahtereh. In India the drug is still highly esteemed by the Mahometans. Jacquemont on his journey from Calcutta to Delhi observed Fumitory growing abundantly in wheat fields near Chittoor and in the Punjab. He describes it as very near to, if not *F. officinalis.* It was probably *F. parviflora*, which is used in Northern India as Fumitory.

For a European account of the properties and uses of Fumitory, Handschuch "*De plantis Fumariaceis*," may be consulted. Fumitory is laxative and diuretic; it is beneficial in dyspepsia depending upon torpidity of the intestines and in scrofulous skin affections. Dose—2 ounces of the decoction (1 ounce to 1 pint) three times a day.

Description.—The dry plant is generally much broken up; mixed with it are many nearly globular, smooth, indehiscent capsules, the size of a large pin's head and umbilicate at the top; seed single, dark brown, crested, with a depression on one side; odour hardly any; taste bitter, slightly acrid and astringent.

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* Dios. 4, 105. Plin. 25, 98, 99. Sibthorp refers the *καπνος* of Dioscorides to *F. parviflora, Lam.*, a plant with white flowers; probably both were used.

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Chemical composition.—Fumitory contains—1*st*, Fumaric acid, $C^4 H^4 O^4$, an acid isomeric with maleic acid, differing from malic acid by containing 1 at. less of water, and from succinic acid by containing 2 at. less of hydrogen; it exists ready formed in several other plants, *viz.*, *Corydalis bulbosa*, *Glaucium flavum*, *Lichen islandicus*, and *Boletus pseudo-ignarius*; it is produced by the dehydration of malic acid, by molecular transformation of maleic acid, namely, when that acid is heated with hydriodic or hydrobromic acid. (*Kekulé*, *Ann. ch. Phar.*, *Suppl.* ii., 85), and according to Multhausen (*Ann ch. Phar. ci.*, 171), is found among the products of the oxidation of protein compounds by nitro-muriatic acid. (*Watts' Dict. of Chemistry.*)

2*nd*, Fumarine, an organic base first observed by Peschier (*Liebig, Organische chemie, p.* 633), and more fully examined by Hannon (*J. Chem. Med.* [3], VIII., 705). The plant gathered while in full flower, contains from 5 to 6 per cent. of this base, to which it appears to owe its specific physiological action. Fumarine is separated from its salts by caustic alkalies or their carbonates in the form of a curdy precipitate; it may be obtained in the crystalline form by spontaneous evaporation of its hot alcoholic solution, but not by evaporation with the aid of heat; the salts have a bitter taste. (*Watts' Dict. of Chemistry.*) According to Preuss, fumarine crystallizes in irregular 6-sided, monoclinic prisms, soluble in alcohol, chloroform, benzol, carbon bisulphide, and amyl-alcohol, sparingly soluble in water, insoluble in ether; its composition has not been determined.

Commerce.—The drug is imported from Persia under the name of Shahterah. Value, about Rs. 4 per Surat maund of 37½ lbs.

The medicinal plants of minor importance belonging to the Fumariaceæ are:—

Hypecoum procumbens, *Linn.*, *Schk. Han.* 1, *t.* 27, found in Sind, Afghanistan, and the Punjab salt range. It appears to be the υπηκόον of Dioscorides, and Hypecoum of Pliny, now known as Cumin cornu or Horned cummin, and like fumitory, a weed of cultivation.

Corydalis Govaniana, *Wall., Royle Ill.*, t. 16, f. 2, a plant of the Western Himalaya, has a yellow juice which is employed medicinally in the treatment of eye diseases like Mámirán. (*Aitchison, Journ. Linn. Soc.* 19, p. 145.) The chemical composition of these plants closely resembles that of Fumaria. They have been used as alteratives, but are of little importance.

CRUCIFERÆ.

ANASTATICA HIEROCHUNTINA, *Linn.*

Fig.—*Jac. Vind.* 1, *t.* 58. Rose of Jericho (*Eng.*), Rose de Jericho (*Fr.*).

Hab.—Syria.

Vernacular.—Kaf Maryam, Kaf Ayesha (*Arab.*), Garbha phúl (*Hind., Guz.*).

History, Uses, &c.—This is a small annual plant growing in sandy wastes in Syria, and is supposed to be the Gurgal, rolling thing, or wheel of Isaiah. There is a tradition that the plant expanded at the birth of the Saviour. Mahometan writers have appropriated this tradition in favour of Ayesha, the favourite wife of the Prophet and mother of the Faithful; the opening of the plant when wetted being considered symbolical of the opening of the womb in childbirth. The branches of Anastatica when in flower, spread out rigidly upon the ground, but when the seed ripens they curl up and form a round ball; this, when placed in water, expands, and the pods after a time open and discharge their seeds; the property of expansion when moist, and closure when dry, is retained for years. There can be little doubt that the dried plant was first introduced into India by the

Mahometans; it is kept in all druggists' shops, and is prescribed in difficult labour, being placed in water until it expands, when the water is administered to the patient. This plant has been supposed by some to be the seed-bearing Amomum of Dioscorides. (*See Primulaceæ.*)

Description.—Stem short and woody, branched in a corymbose manner at the top; leaves obovate, the lower ones entire, the upper remotely toothed; flowers small, yellowish-white, forming spikes along the branches; the fruit is a short pouch with a strong curved beak, and two ear-like projections on each side; it is divided into four cells, each cell containing a yellow concavo-convex seed. The whole plant is tomentose, and has hardly any taste; as seen in the shops, it presents the appearance of a little ball of wicker work about the size of a large egg at the top of the unbranched part of the stem.

Commerce.—It is imported from Syria by way of the Persian Gulf.

LEPIDIUM IBERIS, *Linn.*

Fig.—*Lob. Ic., t.* 223. Peppergrass or Pepperwort (*Eng.*), Passerage ibéride (*Fr.*).

Hab.—Southern Europe to Siberia. The seeds.

Vernacular.—Towdri (*Pers.*).

History, Uses, &c.—These seeds are imported from Persia. In some English books upon Indian Materia Medica they are attributed to *Malva sylvestris*; in others to *Cheiranthus Cheiri*; neither of these suppositions can be correct, as the parcels of seed, when they arrive in Bombay, contain corymbs of small pods, much like those of common Candytuft. Ibn Sina, incorrectly quoting Dioscorides, describes توذري Tozeri as a plant like Farasiyun (πράσιον) with black seeds. (*See Farâsiyun.*) Mír Muhammad Husain gives the following account of Towdrí:—" A Persian name, in Greek Arusiman,* in Arabic Bazr-el-khum-khum, Bazr-el-hawah, and Kasísa; at

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* ερύσιμον of Dios. is generally considered to be *Sisymbrium officinale*.

Ispahan it is called Kadúma; in Kirmán Márdarakht; at Tabriz, Darína. The plant has long leaves, without stalks; the branches are red, stiff and armed with a few prickles; the seed is in a small pod, and of the shape of a lentil, but much smaller; there are three varieties—red, yellow, and white; the latter is the largest. Towdrí is hot in the second degree, and moist in the first: some say dry. Properties aphrodisiac, fattening the body, and purifying the blood." The drug is in general use for the abovementioned properties, which are attributed by the natives to most of the cruciferous seeds. Some of the Towdrí seed is doubtless the produce of *Lepidium Iberis, Linn.*, a plant whose habitat extends from Southern Europe to Siberia. This plant was known to the ancients and employed as a rubefacient in rheumatism, &c.; the seeds taken internally were prescribed in bronchitis and dropsy.* According to Pliny they were first used by Damocrates. Corre and Lejanne state that *L. Iberis* is called Cresson de Savane in the Antilles, and is considered to have all the properties of water-cress.

A tea made from *L. ruderale* is used in Russia in intermittent fevers. A rare pepperwort found in some seaside places in Britain.

Description.—All three kinds are similar in shape to the seeds of Candytuft; the so-called white variety is only somewhat paler than the red; a brown-coloured sort is sometimes met with under the name of "Black Towdrí." When soaked in water the seeds become thickly coated with mucilage.

Chemical composition.—Leroux (1837) obtained from the flowering tops and seeds of *Lepidium Iberis* an amorphous bitter principle which he named Lepidin. The plant also yields a sulphuretted volatile oil.

Commerce.—It is imported from Persia. Value, Red, 3½ annas per lb.; White, 5 annas per lb.

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* λεπιδίον Dios. ii. 165. *ἰβηρὶς* said by Paulus Ægineta in his Third Book to be same as λεπιδιον. See also Plin. 25, 49, App. Herb. 20. Sibthorp refers λεπιδιον to *L. latifolium, L.*, and *ἰβηρὶς* to *L. graminifolium, L.* We may conclude that several species were used.

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Dr. Stewart states that in the Punjab and Sind *Matthiola incana, R. Br.*,* is grown for its seeds, which constitute one of the several kinds of "Todrí." In short this Persian name appears to have much the same meaning as the λευκόϊον of the Greeks, being applied loosely to several Spring flowers. (*See* remarks on *Cheiranthus Cheiri.*)

LEPIDIUM SATIVUM, *Linn.*

Fig.—*Wight, Ill. ii.*, 12; *Smith, Fl. Gr., t.* 616. Common Cress (*Eng.*), Cresson (*Fr.*).

Hab.—Cultivated in all countries. The seeds.

Vernacular.—Hurf, Halim, Chansar (*Hind.*), Assalia, (*Guz.*), Ahaliva (*Mar.*), Ali-virai (*Tam.*), Ádeli (*Tel.*)

History, Uses, &c.—The common cress is generally supposed to be a native of Persia, from which country it was probably introduced at an early date into India. The seeds are called Chandrasura in Sanskrit works, and are described as tonic and alterative; water, thickened with the mucilage which they give out, is recommended in the Bhavaprakása as a remedy for hiccup. The confection or Rábarí containing *ghi* and sugar is used as a restorative tonic, and the seeds are added to purgatives. The Mahometan writers identify cress with the καρδαμον of the Greeks,† and give Hab-el-rashád as the Arabic name for the seeds, which they consider to be hot and dry in the third degree, and to have aphrodisiac and diuretic properties; they recommend them for the dispersion of certain chronic enlargements of the spleen, &c., and as an alterative in various diseased conditions supposed to be produced by cold humours.

Chemical composition.—The herb and seeds of *L. sativum* bruised and macerated and distilled with steam, yield a volatile aromatic oil which does not separate spontaneously from the

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* Purple Gillyflower. Eng. Bot., 1935. Quarantaine (*Fr.*)

† Dios. ii. 144; Nasturtium of Pliny, 19, 44; 20, 50; Theoph. H. P. I. 19; vii. 1, 4, 6.

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watery distillate, but may be extracted therefrom by agitation with benzene. Three-fourths of the crude product boiled at 226·5°, exhibited the composition of pure a-toluonitril, phenyl-aceto-nitril, or phenyl-methyl cyanide, $C^6 H^5 CH^2 CN$, and when heated to 200° for a short time with hydrochloric acid, yielded phenyl-acetic acid. The same composition is exhibited by the volatile oil of *Tropæolum majus*. *Nasturtium officinale* yields by similar treatment an oil which may be separated from the watery distillate by agitation with light petroleum ether, this solvent being afterwards evaporated off in a paraffin bath at 140°. By fractional distillation of the remaining liquid, an oil was obtained, boiling at 253·5° (261° corr.), and having a specific gravity of 1·0014 at 18°. This oil was found by analysis to have the composition of phenyl-propionitril, $C^6 H^5 CH^2 CH^2 CN$; and on fusing it with potash, decomposing the resulting potassium salt with hydrochloric acid, and extracting with ether, phenyl-propionic acid was obtained in long needles melting at 47°. (*Hofmann.*)

The fatty oil of Cress seeds is described by Schübler as of a brownish yellow colour, sp. gr. 0·924; it thickens and becomes turbid at 6° to 10°, and congeals at 15° to a yellow mass. It has a peculiar smell and taste, and dries slowly.

Commerce.—Cress seeds are imported into Bombay from Persia under the name of Assália. Value, Rs. 3¼ per maund of 37½ lbs.

SISYMBRIUM IRIO, *Linn.*

Fig.—*Eng. Bot.* 1631; *Reich., Ic. Fl. Germ., t.* 75, *f.* 4408. Hedge Mustard, London Rocket (*Eng.*), Herbe aux Chantres, Tortelle (*Fr.*).

Hab.—Northern India, Persia, Europe. The seeds.

Vernacular.—Khúbkalán (*Hind.*), Khákshi (*Pers., Bomb.*), Rán-tikhí (*Mar.*).

History, Uses, &c.—There is no notice of this drug in the Hindu Materia Medica; it appears to have been intro-

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duced into the country by the Mahometans as a substitute for *S. officinale*, the ερύσιμον of Dioscorides,* and the Irio of Pliny,† which is reputed to be good for asthma, hoarseness, or any debility of the throat or vocal organs; as also to promote expectoration. In India the seeds are much used in restorative and fattening confections. *S. Irio* was once common about London, and was called London Rocket; it covered the ground in the spring after the great fire of London, and Hallen records that *S. officinale* springs up wherever houses have been burnt. It is a common weed in Persia, and is known by various names in different parts of the country, *e.g.*, in Fars, *Shafterak*; Khorasan, *Khákshí*; Tabriz, *Surdan*; Turkistan, *Shiwaran*; Mazenderan, *Shalumbi.* In Arabic it is called Khubah. Medicinally it is thought to be expectorant, stimulant and restorative; it is also used externally as a stimulating poultice; a large quantity is imported, as it is in constant demand among the Mahometans of India. The plant also grows in Northern India.

Description.—Khákshí is a small red oblong seed about 1-20th of an inch long, one surface is convex, the other grooved, the groove ending in a notch; when placed in water it becomes coated with a transparent mucilage; the cotyledons are yellow and oily. The seed turns rancid if kept for any time; it has a hot flavour like mustard.

Commerce.—It is imported from Persia. Value, Rs. 5 per Surat maund of 37½ lbs.

BRASSICA NIGRA, *Koch.*

Fig.—*Bentley and Trim.*, *t.* 22. Black mustard (*Eng.*), Moutarde noire (*Fr.*). The seeds.

BRASSICA CAMPESTRIS, *Linn.*

Fig.—*Eng. Bot.* 2146. Rape (*Eng.*), Navette, Ravette (*Fr.*). The seeds and oil.

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* Dios. 2, 147; Theophr. H. P. viii. 7.

† Plin. 18, 22; 22, 75. Sibthorp refers ερύσιμον to *S. polyceratium, L.*; probably more than one species was used under this name.

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BRASSICA JUNCEA, *H. f. and T.*

Fig.—*Jacq. Vind., t.* 171. Indian mustard (*Eng.*), Moutarde rouge (*Fr.*). The seeds.

Hab.—Cultivated universally.

Vernacular—B. campestris, Surson (*Hind.*), Sherus (*Mar.*), Sarasava (*Guz.*), Sasave (*Can.*). Other varieties, Rai (*Hind.*, *Guz.*), Kadugu (*Tam.*), Ávélu (*Tel.*), Mohari (*Mar.*).

History, Uses, &c.—One of the Sanskrit names for mustard is Ásuri or "the sorceress," because witches are detected by means of mustard oil. By lamplight several cups are filled with water and the oil dropped in, each cup bears the name of one of the suspected women in the village, and if during the ceremony they observe that the oil takes the form of a woman in any of the cups, they conclude that the person whose name is on that cup is a witch. Mustard is also symbolic of fecundity; in the story of Gul-i-Bakawli, the nymph Bakawli is born again of a peasant woman who had eaten mustard oil extracted from seed grown upon the site of her disappearance. Mustard is mentioned by Greek writers as νάπυ and σινηπι, and appears to have been used by them as a medicine.[*] There is reason to suppose that the Romans used it as a condiment and medicine. *Cf.* Pliny 19, 54 and 20, 87, who mentions three varieties. Fée identifies the slender-stemmed mustard of that writer with the *Sinapis alba* of Linnæus, the mustard mentioned as having the leaves of rape he considers to be the *Sinapis nigra*, and that with the leaf of the rocket, the *Sinapis erucoides* of Linnæus. Sanskrit writers call mustard seeds Sarshapa and notice two kinds, sidhartha or white mustard (*B.campestris*), and rajika or brown mustard (probably *B.juncea*). The first kind is almost exclusively used for the production of the expressed oil,[*] while the brown or black mustards are preferred on account of their greater pungency as rubefacients and for internal administration. The expressed oil of mustard

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[*] Dios. 2, 143.

[†] Colza and Carcel oil of commerce.

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is largely used as an article of diet, and when applied to the skin is considered to keep it soft, cool, and clean, and to promote the growth of hair. In Bengal it is much used by males for rubbing over the body before bathing, females always using cocoanut oil, either plain or perfumed, for the same purpose. Internally the Hindus use mustard combined with other stimulants in dyspepsia and as an emetic; externally they use it in much the same way as we do in Europe, but with the addition of other drugs, most of them of doubtful efficacy. In the Concan the whole seeds, moistened in warm water and sprinkled with lime, are given as a remedy for dyspepsia. In the Makhzan-el-Adwiya three kinds of mustard are noticed. Wild mustard, with small round reddish brown seeds, and two sorts of cultivated mustard, the white and the red. The seeds of the latter are directed to be used for medicinal purposes; they are described as large and not round. The Mahometans consider mustard to be hot and dry, and to have detergent and digestive properties; they prescribe it internally in many diseases in which they think such remedies are indicated; externally they apply it in a variety of ways as a stimulant and counter-irritant. The list of diseases in which it is recommended, and the method of application or administration in each is too long to reproduce here. (*Cf.* Makhzan, article Khardal.) Modern research has shown that essential oil of mustard has antiseptic properties and is destructive of bacteria; it is intensely irritant, and if taken internally would act as a powerful irritant poison. The seeds share its properties, and when powdered and mixed with water act upon the skin and mucous membranes as a stimulant of the circulation, causing heat, redness and pain if the application is short, but vesication and much irritation if too prolonged. It is therefore a most valuable counter-irritant in neuralgic pains and internal congestions. Applied as a hip bath it acts as an indirect emmenagogue by stimulating the circulation. Given internally to the extent of a heaped dessert spoonful in a pint of warm water or gruel, mustard flour acts rapidly as an emetic through its irritant action on the mucous membrane of the stomach, and is therefore useful when narcotics have been taken in poisonous doses. In small doses mustard flour is carminative and sialagogue, and promotes digestion by increasing the flow of saliva and gastric juice. The seeds act in the same way, but owing to their mucilaginous coating the action is more prolonged and milder. During excretion mustard irritates the kidneys and causes diuresis.

Description.—Four kinds of mustard are generally to be found in the Indian market, namely, 1*st*, Karachi mustard, *B. nigra*, var (?)—Globular, of a dark brown colour, surface rough, generally covered with a white pellicle, giving the seeds a grey colour; size about $\frac{1}{16}$ of an inch in diameter.

2*nd*, *B. nigra*—Seeds globular, dark reddish brown, clean and bright; size about $\frac{1}{25}$ of an inch in diameter; surface rough, but less so than that of the 1st kind.

3*rd*, *B. juncea*—Seeds oblong, light reddish brown, clean and bright; length $\frac{1}{12}$ of an inch; surface does not appear rough unless magnified.

4*th*, *B. campestris*—Seeds very slightly oblong, yellow, or reddish brown, clean and bright; diameter $\frac{1}{12}$ of an inch or more; surface smooth to the naked eye, but seen to be finely reticulated under a magnifying glass.

The third kind is preferred by the natives, and may be considered the officinal mustard of India; it has a very bright rich yellow colour when powdered.

Microscopic structure.—The white pellicle which covers the Karachi seeds consists of hexagonal cells. The epidermis of the different kinds of seed consists of one row of closely packed cells, having strong lateral and inner walls; the cells are best seen in the Karachi mustard on account of their greater size.

Chemical composition.—By distilling the seeds (previously macerated) of *B. nigra* and *B. juncea* with water, the pungent

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principle, essential oil of mustard is obtained, amounting to ·2 or ·7 per cent., and under certain conditions more from *B. nigra*. This oil, which has the composition $C\,S\,N\,C^3\,H^5$, allyl thiocarbimide, boils at 150°·7 C., has a specific gravity at 0° of 1·036, no rotatory power, and is soluble without coloration or turbidity in three times its weight of cold strong sulphuric acid. The remarkable reaction which gives rise to the formation of mustard oil was explained by Will and Körner in 1863. They obtained from mustard a crystallizable substance, then termed *Myronate of Potassium*, $C^{10}\,H^{18}\,KNS^2\,O^{10}$, but now known as *Sinnigrin*, from its analogy to *sinalbin*. Sinnigrin when brought into contact with an extract of white mustard or a solution of myrosin, is decomposed into essential oil of mustard, potassium sulphate, and glucose. At the same time a part of the oil is converted into sulphur and crotonitril. (*Roscoe.*) Myrosin is an albumenoid principle contained in white mustard. Its aqueous solution coagulates at 60° C., and then becomes inactive: hence mustard seed which has been roasted yields no volatile oil, nor does it yield any if powdered and introduced at once into boiling water. Sometimes black mustard contains so little myrosin that white mustard has to be added to it in order to develope all the volatile oil it is capable of yielding. Sinalbin is another compound contained in white mustard seed; it is easily soluble in water, less so in alcohol, and crystallizes in small pearly needles. By the action of myrosin it is converted into sinalbin-mustard-oil, and sulphate of sinapine and glucose. For further information the reader is referred to Roscoe and Schorlemmer's work on Organic Chemistry.

The seeds, roots and herbaceous parts of many of the Cruciferæ yield a volatile oil composed in part of mustard oil and in part of allyl sulphide, $C^6\,H^{10}S$, which is also obtainable from garlic. Many Cruciferæ afford from their roots or seeds chiefly or solely oil of mustard, and from their leaves oil of garlic.

The following percentage analyses of mustard seeds are given by König (*Zusamm. d. mensch. Nahrungs, &c., p.* 148) :—

	Description.	Date.	Water.	Nitrog. Matters.	Fixed Oil.	Myron. Acid.	Bitter Salt.	Cellulose.	Ash.	In dry substance.		By whom examined.
										Nitr.	Oil	
1	....	1863	7·50	18·36 Myrosin + Albumin	26·20	...	...	...	4·00	...	28·25	R. Hoffman.
2*	Black mustard seed.	1876	4·84	29 53	35·70	4·81	3·59	(16·76)	4 72	5·32	37·52	H. Hassall.
3*	White do ...	,,	5·36	27·48	35·76	...	10·99	(16·29)	4·11	5·55	37·79	
4*	Do. Yorkshire.	1881	9·32	28·37†	25·56	...	...	10·52	4·57	5·00	28·19	Piesse and Stansell.
5*	Do. Cambridge.	,,	8·00	28·06†	27·51	...	...	8 87	4·70	4·88	29·90	
6*	Black do. Cambridge.	,,	8·52	26·50†	25·54	1 69	...	9·01	4·08	4·79	27·92	
	Average.....		7·26	27·99	29·35	3·24	(17·66)‡	12·29	4·18	5·11	31·48	

* Containing—		Volatile Oil.	Nitrogen.	Sulphur.
Mustard Seed No. 2	...	1·271	5·0[illegible]8	1·413
,, ,, 3	...	......	5·235	1·224
,, ,, 4	...	0·06	4·54	0·99
,, ,, 5	...	0·08	3·49	0·93
,, ,, 6	...	0·47	4·38	1·28

† Containing Myrosin + Albumin No. 4, 5·24. No. 5, 4·58. No. 6, 5·24 per cent.
‡ Calculated by difference

Mustard seeds submitted to pressure afford about 23 per cent. of a mild-tasting,* inodorous, non-drying oil, solidifying when cooled to —17·5° C., and consisting of the glycerin compound of stearic, oleic and erucic or brassic acid. The last named acid occurs also in rape, and grape seed oils, and is homologous with oleic acid.

The ash constituents of mustard, amounting to 4 per cent., consist chiefly of the phosphates of calcium, magnesium and potassium.

The mustard oil sold in the bazars of India has a pungent odour and bitter taste, owing to the practise of watering the cake before pressing it the second time. It is also said to be largely adulterated in Bengal with poppy seed and other oils. Through the kindness of Mr. Blechenden, Secretary, Agri-Horticultural Society of India, we have had an opportunity of

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* When freshly-expressed it has the taste of mustard without th pungency.

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examining a specimen of pure mustard oil expressed in a Merce's patent iron mill at the Calcutta Exhibition of 1884. The oil was of a pale yellow colour, with a somewhat nutty and very faintly pungent taste, and faint odour of mustard. At 15°·5 C. it had a specific gravity of ·9286. At —9° C. it became as viscid as thick treacle.

The seeds of *B. campestris* yields a brownish-yellow, nearly inodorous and tasteless oil, having when expressed hot, or when long kept, a disagreeable after taste. Sp. gr. about 0·9136. (*Schübler.*) It is the least limpid of the Brassica oils, at —4° it deposits a little fat, and solidifies to a yellow butter at —6°. The cold-pressed oil contains, on the average, 70·32 per cent. carbon, 10·58 hydrogen and 19·10 oxygen; it forms with chlorine a yellow, very viscid compound containing 17·68 per cent. of chlorine, and with bromine a similar compound containing 32·5 per cent. of bromine. *B. campestris* contains myrosin but no sinnigrin.

According to W. J. Smith (*Zeit. Phys. Chem. xii.*, 419), the greater part of the sulphur occurs combined in the glucosidal compound sinnigrin, a smaller quantity occurs not so combined; and in addition there is that which is present as a constituent of albumen. With the germination of cruciferous seeds the glucoside is gradually broken up, but after an interval of several weeks some of it reappears in the leaves of the plant. The rate at which the glucoside in these seeds is broken up in the presence of water was found to vary considerably in different species, and it was further found that the ferment from any cruciferous seed is capable of breaking up the glucoside of any other cruciferous seed. It is therefore inferred that all these seeds contain one and the same ferment, whilst, on the other hand, the glucosides of different species vary considerably in respect to their susceptibility to the ferment.

According to Messrs. Schimmel, the quantity of sulphuretted oil yielded by *Brassica nigra* seeds is 0·90 per cent., and by the seeds of *B. juncea* 0·52 per cent.

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Commerce.—Mustard is grown in most parts of India, the price ranges from Rs. 20 to Rs. 40 per candy according to quality and cleanness of seed. Rape is worth about Rs. 7 per cwt.

RAPHANUS SATIVUS, *Linn.*

Fig.—*Lam. Ill., t.* 566. Radish (*Eng.*), Radis (*Fr.*).

Vernacular—Mula, Muro (*Bomb., Hind.*), Mullangi (*Tam., Can.*), Mulaka (*Sans.*).

Description.—A large, coarse white radish, is universally cultivated in India. The seeds Bazr-el-fujl (*Arab.*) are used as a diuretic, laxative and lithontriptic; also the juice of the fresh leaves. The root and seeds yield with water a milky distillate, from which a small quantity of oil may be obtained by rectification; it is colourless, heavier than water, and has the taste but not the smell of radishes. The oil contains sulphur; it forms a white precipitate with corrosive sublimate, and yellow with bichloride of platinum. It dissolves with tolerable facility in water.—(*Pless, in Gmelin's Handbook, X.*, 56).

The following percentage analyses of Radishes are given by König (*Zusamm. d. mensch. Nahrungs, &c., p.* 137):—

When collected	Water.	Nitr. subs.	Fatty matter.	Sugar.	Non-nitr extractive.	Cellulose.	Ash.	In dry substance.		By whom examined.
								Nitr.	Carbo. Hydr.	
* May 1874 …	91·31	1·15	0·09	1·14	1·97	0·65	0·67	3·28	54·66	W. Dahlen.
† Oct " …	93·47	1·45	0·11	0·52	2·80	0·73	0·93	3·55	50·84	
1876 …	92·23	1·09	0·26	4·92		0·87	0·6[illegible]	2·24	63·32	R. Pott.
Average ……	93·34	1·23	0·15	0·88	2·91	0·75	0·74	3·01	56·27	

* It contained Phosphoric acid 0·057, and Sulphur organically combined 0·011 per cent.

† It contained Phosphoric acid 0·090, and Sulphur organically combined 0·023 per cent.

The other Cruciferous plants known in India, which are more or less medicinal, are the following :—

Cheiranthus Cheiri, *Linn.*—The Wallflower is cultivated in Northern India under the name of Todri. This plant and *Matthiola incana* are considered by many to have been the λευκόϊον of the Greeks and Viola of the Latins, names which appear to have been rather loosely applied to several Spring flowers. The Germans still call the Wallflower 'Leucoje' and the French know it as Violier as well as Giroflée. Leukoion is described as emmenagogue and deobstruent by Dioscorides, and the Mahometans of India attribute such virtues to the flowers. The seeds contain myrosin and the same oil as *Raphanus sativus*.

Nasturtium officinale, *R. Br.*—The Water-cress is a native of Northern India, and is largely cultivated in many parts of the country. As a salad it has from time immemorial been held in esteem on account of its appetizing and antiscorbutic properties.

Cardamine pratensis *Linn.*—The Cuckoo-flower or Ladies-smock occurs in Hussora, and has properties similar to *Nasturtium officinale*. The same may be said of the several species of Farsetia which grow in the Punjab.

Eruca sativa, *Lam.*—The Rocket is cultivated in Northern and Central India, and has similar properties, but is more acrid ; it is the εὔζωμον (good brothmaker) of the Greeks and Eruca of the Latins. The Arabians call it جر جير (Jarjir) and the Persians ایهقان (Eihukan). The Mahometans say that if a sour Pomegranate is watered with its juice, the fruit will become sweet.

The medicinal action of these Cruciferous plants resembles that of Mustard.

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CAPPARIDEÆ.

CLEOME VISCOSA, *Linn.*

Fig.—*Wight Ic.*, *t.* 2; *Rheede ix.*, *Hort. Mal. ix.*, *t.* 23. Sticky Cleome (*Eng.*), Herbe puante, Brede puante (*Fr.*).

Hab.—Tropical India and other warm climates. The plant and seeds.

Vernacular.—Húlhúl, Húrhúr (*Hind.*), Húrhúriá (*Beng.*), Kanphútí, Pivala-tilávana (*Mar.*), Nai-vela. (*Tam.*), Kukka-váminta (*Tel.*), Hucha sásavi (*Can.*).

History, Uses, &c.—This common weed on cultivated ground appears to have been long in use in India as a domestic remedy; it is called in Sanskrit Adityabhaktá and Arkakánta. Ainslie says:—"The small compressed, netted surfaced, hottish tasted seeds have got the Tamool name of Nahi Kuddághoo, or 'dog's mustard,' and are considered by the Vytians as anthelmintic and carminative; they are administered in the quantity of about a tea-spoonful twice daily." The juice of the leaves, Rheede says, "is useful in deafness poured into the ears." This account agrees with the way in which the plant is used at the present time, the juice mixed with oil being a popular remedy for purulent discharges from the ear; hence the name Kánphútí.* It is the *Herbe-puante* or *Brede-puante* of the French Settlements in the East. Descourtilz says that when crushed and applied to the skin it causes much redness and even vesication. Given internally it is sudorific; when cooked it loses its acrid properties. Rumphius gives a similar account of its properties, and says the Portuguese call it Bredo Mamma.

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* The juice of plants was used in this way by the Greeks and Romans. Scrib. Larg. Comp. 39. Ad auriculæ et tumorem et dolorem sine ulcere prodest herbæ urceolaris, aut cucurbitæ ramentorum succus tepens per strigilem in foramen auris dolentis infusus.

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Description.—An annual weed from 1 to 3 feet high; leaves 3 to 5-foliolate, leaflets obovate; flowers yellow; the whole plant pubescent and extremely viscid; many of the hairs are surmounted by a round gland, from which a reddish viscid secretion exudes; the plant has a powerful odour like black currants. The capsules are from 2 to 3½ inches long, striated, pubescent, tapering towards the point, which is surmounted by the style; the seeds are dark brown or nearly black, reniform, and granular, about the size of black mustard seed; the leaves have a pungent flavour, and the seed a feeble taste of mustard.

GYNANDROPSIS PENTAPHYLLA, *DC.*

Fig.—*Rheede, Hort. Mal. ix., t.* 24.

Hab.—India and all tropical countries. The plant and seeds.

Vernacular.—Húrhúr, Húlbúl, Karaila (*Hind.*), Hurhuriá (*Beng.*), Váminta (*Tel.*), Tilávana, Máblí (*Mar.*), Vela, Taivela (*Tam.*), Waila (*Cing.*).

History, Uses, &c.—The five-leaved Cleome, as it was formerly called, has been long known as a domestic remedy by the Hindus; it is called in Sanskrit Surjavarta and Arkapushpika, and is noticed by Ainslie, who says, "That the small numerous, warmish kidney formed black seeds, as well as leaves of this plant, are administered in decoction in convulsive affections and typhus fever, to the quantity of half a teacup full twice daily." The natives regard it as having much the same properties as *Cleome viscosa.* In the French colonies and in the Nilgiris it is used as a sudorific. In Pudukota the leaves are applied to boils to prevent the formation of pus. Wight (*Ill. I., p.* 34) says that the bruised leaves are rubefacient and vesicant.

Description.—A common plant on cultivated ground; leaves 5-foliolate, with obovate leaflets; flowers white or

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purplish, in glutinous racemes, bracts 3-foliolate; stamens very long, purple; capsules 2 to 4 inches long, tapering towards the point, which is surmounted by the style, striated, pubescent. The whole plant is viscid and covered thickly with glandular hairs; it has a strong peculiar odour like the black currant leaf. The seeds are black, of the same shape and size as those of *Cleome viscosa,* but rougher; they have a very faint flavour of mustard.

Chemical composition.—These plants when crushed in the fresh state develop an acrid volatile oil having the properties of garlic or mustard oil. The dried plants exhausted by alcohol yield a deep green tincture which on evaporation leaves a brown soft resin which has no irritant action when applied to the skin.

CRATÆVA RELGIOSA, *Forst., var. Nurvala.*

Fig.—*Rheede, Hort. Mal. iii., t.* 42. Holy Garlick Pear (*Eng.*), Tapier (*Fr.*).

Vernacular.—Brarna, Bilasi, Bila (*Hind.*), Barun, Tikoshak (*Beng.*), Maralingam (*Tam.*), Nirvala (*Can.*), Uskia, Urumatti (*Tel.*), Vayavarna, Haravarna, Rámala, Karvan (*Mar.*).

Hab.—Malabar, Canara. Cultivated elsewhere. The leaves and bark.

History, Uses, &c.—This small tree is a native of Malabar and Canara, Tropical Africa, and the Society Islands; it is also found planted about temples and Mahometan tombs in many parts of India. It is worthy of remark that this tree is found planted near tombs in several different parts of the world. The Sanskrit names are Varuna and Asmarighna (lithontriptic). Mr. U. C. Dutt gives the following summary of its properties as described in Sanskrit works:—"It is said to promote the appetite, increase the secretion of the bile, act as a laxative, and remove disorders of the urinary organs. In calculous affections it is used in a great variety of forms; thus a simple decoction of the bark may be given with the

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addition of treacle. A compound decoction is prepared along with equal parts of *Tribulus terrestris* and ginger; and is administered with the addition of Yavakshára (impure carbonate of potash) and honey. A compound powder, *Varunádya churna*, is prepared as follows:—A solution of the ashes of *Varuná* is made; this solution is boiled with the addition of the bark in powder and Yavakshára till the water is entirely evaporated, the resulting powder is given in ascites, calculus, enlargements of the abdominal viscera, and affections of the bladder and uterus. A confection, called *Varunádya guda*, is prepared by adding to the fluid extract of the bark, treacle, and a number of diuretic and aromatic substances." The leaves are used as a remedy for swelling of the feet, and a burning sensation in the soles of the feet, a common complaint of a somewhat obscure nature; they are also cooked and eaten as a vegetable to reduce corpulence. The leaf-juice is given in rheumatism in the Concan in doses of ½ to 3 tolas mixed with cocoanut juice and *ghi*. In caries of the bones of the nose the leaf is smoked and the smoke exhaled through the nose. The bark and leaf pounded and tied in a cloth are used as a fomentation in rheumatism. In physiological action this bark resembles Caper bark. (*See next article.*) A tincture has been found to be an excellent emulsifying agent.

Description.—Leaves 3-foliolate, on long petioles, leaflets lanceolate acuminate, thin, smooth, upper surface dark green, under surface of a lighter colour, about 8 inches long and 3 inches broad. When bruised they have a disagreeable smell, something like Hellebore; taste slightly bitter and very pungent, causing a tingling sensation in the tongue, not aromatic. The bark is grey externally, and minutely fissured, thick; fracture short; beneath the grey epidermis is a green layer, substance white; a transverse section shows numerous yellow specks, which when examined with a lens, are seen to be bundles of very large stone cells. The taste is faintly bitter.

Chemical composition.—The bark contains saponin, or a principle similar to it.

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CAPPARIS SPINOSA, *Linn.*

Fig.—*Var. 2, rupestris, Sibth., Flor. Græc., t.* 487. *Var.* 3, *vulgaris, Royle, Illus.* 73. *Var.* 4, *leucophylla, Deless. Ic. Sel. iii., t.* 10. Caper plant (*Eng.*), Caprier commun (*Fr.*).

Hab.—Europe, Asia, Africa, &c. The bark of the root.

Vernacular.—Kabar (*Arab.*).

History, Uses, &c.—This plant is widely distributed, being found in Afghanistan, West Asia, Europe, North Africa, Australia, and the Sandwich Islands. The common Indian and Oriental form, Var. 3 of Hooker's *Flora of British India* grows on hilly ground in many parts of India. Caper bark does not appear to have been known as a medicine to the Hindus until introduced by the Mahometans, but the fruits of *C. sepiaria, Linn.* (Kákádani), and of *C. aphylla, Roth.* (Karira), are mentioned by Sanskrit writers. Capparis is mentioned by both Greek and Latin writers,* and its medicinal properties were probably made known to the Arabs through them. The Syrian name is Kabár and the Turkish Kabarish; in Persia it is called Kabár and Kárak. The author of the Makhzan-el-Adwiya gives a good description of the plant, and says that the root bark is the most active part, and generally used. He considers it to be hot and dry, and to act as a detergent and astringent, expelling cold humors; it is therefore recommended in palsy, dropsy, and gouty and rheumatic affections; the juice of the fresh plant is directed to be dropped into the ear to kill worms, just as Cleome juice is used in India; all parts of the plant are said to have a stimulating and astringent effect when applied externally. Ainslie mentions the drug as an imported article, and notices its use as an external application to malignant ulcers. The physiological action of Caper bark is very similar to that of Senega, and depends upon the presence in it of a principle similar to, if not identical with, saponin (*see Saponaria Vaccaria*). The

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* Dios. ii., 164. καππαρις or κάππαρι. Theophr. H. P. i. 6; iii. 3; vi. 3, 5; vii. 8; Plin. 13, 44; 20, 59. Cels. 4, 9.

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fresh plant develops a volatile oil having the properties of garlic oil.

Description.—Caper root bark occurs in half quills several inches in length; it is very thick and transversely fissured; the external surface is gray, the internal white, taste bitter and pungent.

Chemical composition.—The root bark, according to Rochleder and Blas, contains a neutral bitter principle of sharp irritating taste, resembling senegin. The flower buds distilled with water yield a distillate having an alliaceous odour. After they have been washed with cold water, hot water extracts from them capric acid ($C^{10} H^{20} O^{2}$), and a gelatinous substance of the pectin group; capric acid is sometimes found deposited on the calices of the buds in white specks having the appearance of wax. (*Watts' Dict. of Chem.*) Förster has isolated a glucoside from the plant which yields, on boiling with sulphuric acid, isodulcite, and a colouring matter similar to quercetin. Similar glucosides were also found in *Sophora japonica* and *Ruta graveolens.* (*Ding. Polytech. Journ.*, 245, 48; *Year-Book Pharm.*, 1883, *p.* 241.)

Commerce.—The drug is imported *via* the Persian Gulf. Value, Re. ½ per lb.

The root of **C. zeylanica**, *Linn.*, **C. acuminata**, *Roxb.*, *Vern.* Kálu-kera (*Beng.*), Paliki (*Tel.*), Waghanti (*Mar.*), Govindphal (*Hind.*), Authúndi-kai (*Tam.*), is reputed to be a cooling medicine.

The young shoots of **C. aphylla**, *Roth.*, *Vern.* Karil, and of **C. horrida**, *Linn. f.*, *Vern.* Ardanda, are applied medicinally as a counter-irritant. The unripe fruits of both species are used as a pickle with pepper, mustard and oil. In Puducotta the fruits of **C. grandiflora**, *Wall.*, are pickled; its Tamil name is Killacchedi.

CADABA TRIFOLIATA, *W. & A.*

Fig.—*Hook., Bot. Misc.* 296; *Suppl. t.* 37.

Hab.—Carnatic, Ceylon.

C. INDICA, *Lamk.*

Fig.—*Burm. Ind. t.* 46, *f.* 3.

Hab.—W. Peninsula.

C. FARINOSA, *Forsk.*

Fig.—*Deless., Ic. Sel. iii.*, t. 8.

Hab.—Punjab, Sind, Arabia, Africa.

Vernacular.—*C. trifoliata*, Viluthee, Maunthakkooroonthu (*Tam.*), Checkonadi (*Tel.*). *C. indica*, Velivi (*Tam.*). *C. farinosa*, Asal, Sarah (*Arab.*).

History, Uses, &c.—The genus derives its title from Kadhab (قظيب or قضب), an Arab name for the *C. rotundifolia* of Forskal, who mentions another species (*C. farinosa*) as medicinal. He says: "Usus antitoxicus: dum rami recentes et minores masticantur, vel pulveris forma eduntur." The latter plant, under the name of سرح is described by Az, from information given to him by an Arab of the desert, as a shrub with a dusty colour, not so tall as the tamarisk (اثل), with small leaves and lank branches or twigs, and always growing slanting. A species of Cadaba is very common in Socotra, and Balfour suggests that the village of Kadhab on the northern shores of that island may have taken its name from this plant, which grows abundantly on the plain in its vicinity.

In Padukota the root and leaves of *C. indica* are used in decoction as an anthelmintic, and the juice of the leaves of *C. trifoliata* is given to children suffering from indigestion.

According to P. S. Mootooswamy of Tanjore the trifoliate Cadaba is common on the sites of ruined temples and other buildings, and the leaves are considered to be purgative, emmenagogue, antisyphilitic, anthelmintic and antiphlogistic; they are much employed in preparing medicated oils. As a purgative half an ounce of the leaves may be used in decoction like senna with sulphate of magnesia, but the natives usually administer them with myrobalans and ginger; given in this manner they appear to have much the same action as senna. In combination with castor-oil and turmeric the decoction is prescribed by native doctors in amenorrhœa and dysmenorrhœa. The boiled leaves are eaten as an anthelmintic, and are applied externally to rheumatic joints; together with the leaves of *Odina Wodier* and child's urine they are applied as a poultice to phlegmons to promote suppuration. The pods are boiled, dried, soaked in buttermilk, again dried, and fried with melted butter (*ghi*) as a vegetable. The medicinal properties of the root are similar to those of the leaves. *C. trifoliata* is supposed to be the Balaya of Sanskrit writers.

Description.—*C. trifoliata* has palmately 3-foliolate leaves, with oblong or lanceolate leaflets about 2 inches in length. The leaves of *C. indica* are simple ovate or oblong acute or mucronate, from 1 to 1½ inches long. The leaves of *C. farinosa* are hoary, ovate or oblong obtuse and seldom an inch in length.

Chemical composition.—The ethereal and alcoholic extracts of the leaves of *Cadaba indica* yield to acidulated water a somewhat bitter alkaloid giving crystallisable salts when evaporated. No tannin is present, but an organic acid precipitable from a concentrated aqueous extract by an equal volume of alcohol. This acid is combined as a calcium salt, and yields when burnt 21 per cent. of carbonate. Another acid of a dark colour is found in the same extract; it is precipitated by four volumes of spirit, and resembles in some of its reactions cathartic acid.

The leaves contain a considerable quantity of nitrates, recognised by their slight deflagration when burning; and by showing the peculiar ring with the sulphuric acid and iron test, even in the cold infusion.

The dried and powdered leaves after complete combustion leave 16·5 per cent. of white ash, of which more than one-half is soluble in water, and consists of alkaline chlorides, carbonates and sulphates.

VIOLACEÆ.

IONIDIUM SUFFRUTICOSUM, *Ging.*

Fig.—*Wight. Ill., t.* 19; *Ic., t.* 308.

Hab.—Tropical Asia, Africa and Australia. The plant.

Vernacular.—Ratanpurs (*Hind., Mar.*), Orilatamaray (*Ṭam.*), Purusharatanam (*Tel.*), Nunbora (*Beng.*).

History, Uses, &c.—In Southern India this plant is considered to be one of the two kinds of Chárati mentioned by Sanskrit writers, a synonym for which is Padma-chariní. The native physicians regard it as a tonic and diuretic, and prepare a *paka* or confection of the whole plant. Twenty to sixty grains of the plant are administered in each dose.

Rheede and Ainslie mention Chárati. According to the latter writer, the leaves and tender stalks are demulcent and are used by the natives in decoction and electuary, and also employed in conjunction with some mild oil, in preparing a cooling liniment for the head. The plant is more or less known for its medicinal properties from Agra to Ceylon, and is often used in Southern India as a demulcent in gonorrhœa, and its demulcent properties are known in N. S. Wales, where the plant is common.

Description.—The drug as sold in the shops consists of the root and some of the leafy portion of the plant attached to it; the roots are yellowish-white, 3 to 4 inches in length,

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about $\frac{1}{12}$th of inch in diameter at the upper part, gradually tapering downwards, woody and tough, and covered with a corky bark. Stems woody; leaves small, alternate, sub-sessile, lanceolate. Taste mucilaginous.

Chemical composition.—The root contains an alkaloid soluble in ether and alcohol, not easily crystallized; its solution in the form of a salt, which it readily forms with the mineral and vegetable acids, is precipitated by potassio-mercuric iodide, iodine in potassium iodide, tannin and the alkalies. It also contains quercitrin, allied to the viola-quercitrin of Mandelin; and another colouring matter soluble in water, but insoluble in amylic alcohol; an acid resin; and a quantity of mucilage and oxalates.

VIOLA ODORATA, *Linn.*

Fig.—*Bentl. and Trim., t.* 25. March Violet (*Eng.*), Violette odorante (*Fr.*).

Hab.—The north temperate zone. The plants and flowers.

Vernacular.—Banafshah (*Pers., Hind., Bomb.*).

History, Uses, &c.—The Greeks made use of this herb as a medicine,[*] and from them and their works the Mahometans probably became acquainted with its properties; it does not appear to have been used by the early Hindu physicians. A long account of its properties will be found in most Arabic and Persian works on Materia Medica; it is generally considered cold and moist, and is especially valued as a diuretic and expectorant, and as a purgative in bilious affections; it is seldom given alone, but is prescribed along with other drugs, which also have an aperient action, such as tamarinds, myrobalans, &c. The diseases in which Banafshah

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[*] Dios. iv. 117. Viola, Latin, digammated from *ἴον* Plin. 21, 14, 76. Theophrastus H. P. VI., 6, 7, mentions *ἴον* the flower and *ἰωνια* the plant, of which there are two kinds, black and white.

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is recommended are too numerous to be mentioned here; suffice it to say that they are generally those in which a cooling treatment is thought to be indicated by the hakims. The root has been tried by European medical men in India as a substitute for Ipecacuanha, but according to the Bengal Dispensatory, without satisfactory results. Native doctors consider the purple-flowered variety to be the best; they use the flowers separately, and also the entire plant.

Description.—The root is as thick as a crow quill, very crooked, and furnished with a number of thin radicles; it has a spongy bark, and a hard woody meditullium; the colour is pale yellow; odour and taste not peculiar.

Chemical composition.—The flowers are said to contain, besides colouring matter, slight traces of a volatile oil, three acids, one red and the other colourless, and salicylic acid; an emetic principle called violin, probably identical with emetine; violaquercitrin in close relation to, but not identical with, quercitrin or rutin (*Mandelin*); and sugar, &c. The colouring matter of the flowers is easily turned red by acids, and green by alkalies, and hence the syrup of violets was formerly used as a reagent. The colourless acid called violenic acid by Peretti, is said to crystallize in silky needles, to be soluble in water, alcohol, and ether, and to form yellow salts which stain the skin. According to Boullay, all parts of the plant contain violin. The ash of *V. calaminaris* (yellow violet) growing in Rhenish-Prussia in soil in which zinc is present, has been found to contain that metal.

Commerce.—Violet flowers (Gul-i-Banafshah) and the plant (Kashmiri Banafshah) are the two forms of this drug met with in the Indian markets; the first is generally imported from Persia, and consists of the flowers of the purple violet; the second comes from Cashmere, and is the whole plant in flower; it seems to be a white or yellow flowered variety. In Northern India *Viola cinerea, Boiss.*, and *V. serpens, Wall.*, are used as substitutes for *V. odorata*, and are called Banafsheh.

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BIXINEÆ.

GYNOCARDIA ODORATA, *R. Br.*

Fig.—*Bentl. and Trim.*, *t.* 28.

Hab.—Sikkim and Khasia hills to Chittagong, Rangoon and Tenasserim. The seeds.

Vernacular.—Chaulmugra (*Hind.*, *Bomb.*), Tùk-kung (*Lepcha.*).

History, Uses, &c.—We know very little of the history of this drug, but it seems that the inhabitants of South Eastern Asia have for a long time been in the habit of using the seeds of this and of another nearly allied species as a remedy for leprosy. The fruits grow upon the stems and main branches of the tree. The hill tribes in Sikkim use the pulp to poison fish, and after boiling it with water, as a food. The bark is said to be used as a febrifuge; it contains tannin, and its infusion has the odour of essential oil of bitter almonds. There has lately been a demand for it from the Mauritius. Hanbury has pointed out that a seed very similar to Chaulmugra is exported to China from Siam, under the name of *Lukrabo*, and that it differs from Chaulmugra in having a stronger testa. In the Makhzan-el-Adwiya there is a short notice of the seeds under the name of *Chawul mungri*; their use in leprosy and other skin diseases is mentioned both as an internal and external remedy. In native practise the oil is administered mixed with clarified butter; this mixture is of a brownish yellow colour, and of the consistence of a soft ointment; it is often adulterated. Roxburgh, and the authors of the Bengal Dispensatory, briefly notice Chaulmugra, but of late years it has become better known to Europeans, and has been extensively used in many parts of India with a favourable result. In the *Indian Annals of Medical Science*, April, 1856, it was brought to notice as a remedy for secondary syphilis. It was first given as a remedy for phthisis and scrofula by Dr.

R. Jones of Calcutta, in doses of six grains three times a day. In 1868 it was made officinal in the Pharmacopœia of India, where an ointment is directed to be made from the pounded kernels mixed with Ung. Simplex. Within the last few years the oil has been used in several of the London hospitals as a remedy for stiff joints caused by rheumatism, being rubbed in, and also given internally in doses of 3 to 4 minims three times a day after meals; the dose may be gradually increased. For children 1 to 2 minims once a day is sufficient; it may be combined with cod-liver oil. Dr. Young, of Florence, has used the oil with advantage in macular and anæsthetic leprosy; during treatment bronchial affections disappeared. In America it has been used as a remedy for sprains and bruises and for sciatica; over-doses (10 minims three times a day) cause vomiting and purging with loss of appetite, but all people are not equally affected by the drug. In chest affections and phthisis it may be rubbed into the chest with advantage. People taking it should live generously; native Indian doctors recommend abstinence from meat, sweets, spices and acids during its use. Dr. Wyndham Cottle writes to the *British Medical Journal* on Chaulmugra oil and its active principle, Gynocardic acid, as internal and external remedies in various forms of skin disease. Gynocardic acid he finds preferable for several reasons, as it rarely produces nausea, can easily be given in the form of pills, and is more uniform. Both the oil and gynocardic acid are used either as external or internal remedies, the oil being taken best in *perles*; and the oil and the acid best applied as ointments in combination with vaseline. Dr Cottle seems to have found these medicines most serviceable as local applications in eczema. In eczema of the face, and when it shows itself in dry patches, he has found an ointment of gynocardic acid of from 15 to 25 grains to the ounce of vaseline, almost a specific, when most of the ordinary applications in use only served to aggravate the local mischief. The ointment should be applied three or four times daily, so as to keep the affected parts lubricated with it. Again, in eczema of the hands, such an ointment is the most generally useful application with which he is acquainted. In

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the acute form of this disease, or where there is much discharge, the good effects following the use of Chaulmugra oil, or gynocardic acid, locally applied, are not so marked. For internal administration it is well to begin with about four minims of the oil, or half a grain of the acid, taken after food, twice or thrice daily, and gradually increased to from half a drachm to one drachm of the oil, or one to three grains of the acid. An aperient should be given at the same time if necessary. The oil may be given in emulsion; it is convenient to have the gynocardic acid made into pills containing half a grain of the acid, with three grains of extract of gentian, extract of hops, or conserve of roses. To commence, one such pill may be given thrice daily. The amount may be gradually increased to three or four pills for each dose. The writer adds that the constitutional effects of the drug may be produced by inunction, and he suggests that a soap in which gynocardic acid was incorporated would probably possess much of the soothing and remedial influences of the gynocardic acid, and prove useful in the treatment of many forms of skin disease.

Description.—The fruit is globular, from 3 to 5 inches in diameter, with a thick hard rough rind, and contains a number of irregularly ovoid seeds in a scanty pulp. The seeds are from 1 to 1¼ inch long, more or less angular or flattened by mutual pressure; they average about 35 grains in weight. The testa is thin, brittle, smooth and of a dull grey colour; the albumen is copious, white when fresh, but brown in the dried seeds and oily, and encloses a pair of large, plain, leafy heart-shaped cotyledons with a stout radicle; the odour of the seed is nauseous and peculiar.

Microscopic structure.—The testa consists of an outer and an inner layer of stone cells placed parallel to the surface of the seed, the space between them being occupied by two or three rows of similar cells, the long axes of which are arranged nearly at right angles to those of the exterior cells. (*Moeller.*) The albumen exhibits large angular cells containing fatty oil, masses of albuminous matter, and tufted crystals. Starch is not present.

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Chemical composition.—In the hydraulic press the seeds yield from 25 to 30 per cent. of oil, to ether 51·5 per cent. The oil is sherry-yellow. Sp. gr. ·9450 at 85° F., and turns green with the sulphuric acid test (*cf. Phar. Journ., March* 25, 1876), it deposits in cold weather a quantity of crystalline fat. A chemical examination of the oil, by Moss, has shown that the existence of any alkaloidal substance is doubtful, at least so far as to account for any medicinal efficacy. He finds it to contain a peculiar fatty acid, gynocardic 11·7 per cent., associated with palmitic acid 60·0 per cent., hypogœic acid 4·0 per cent., and cocinic acid 2·3 per cent., in combination with glyceryl as fats, and the two former in the free state as well. Gynocardic acid crystallizes in yellowish plates, melts at 85° F., has an acrid burning taste, probable formula $C^{14} H^{24} O^{2}$; it strikes a green colour with sulphuric acid. Moss also found that palm oil gave a similar reaction. The chemistry of Chaulmugra has recently (1885) been investigated by E. Heckel and F. Schlagdenhauffen, who consider the following test to be characteristic of the oil. They direct the oil to be mixed with an ethereal solution of ferric chloride, and the mixture to be evaporated until the oil becomes of a dirty green colour; it is then allowed to cool, and a few drops of sulphuric acid are added, which produce a fine greenish-blue colour. The colouring matter may be dissolved out by chloroform, with which it forms a dichroic solution like that of chlorophyll. This solution gives a deep absorption band extending from 40° to 70° of the scale (the sodium-ray coinciding with 50°). In proportion as the solution is diluted the black band becomes fainter, until, with a very weak solution, only a narrow very pale band can be seen, extending between 40° and 48° of the scale.

The following is the result of the analysis of the seeds:—

Soluble in water	9·175	Glucose..................	0· 50
		Fixed salts..............	1· 114
		Albumenoid matters...	1·2675
		Colouring matters, &c.	6·2935

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Fatty matters soluble in Petroleum	30·120		30·120
Fatty matters soluble in Chloroform	0·505		0·505
Soluble in methylic alcohol	5·405	Glucose	0·54
		Albumenoid matters	0·4206
		Fixed salts	0·090
		Non-nitrogenized organic matters	4·3544
Residue insoluble in methylic alcohol.	49·009	Albumenoid matters.	23·8740
		Fixed salts	4·845
		Cellulose and other non-nitrogenized matters	20·290
Moisture	5·786		
	100·000		

—(*Journ. de Phar. et de Chim., April* 1st, 1885.)

Commerce.—The seeds are collected in the Lower Himalayas in December and are brought to Calcutta. Value about Rs. 12 per Bengal maund of 80 lbs. Of late years a false Chaulmugra seed has occasionally found its way to India. It has a thicker shell and yields less oil.

False Chaulmugra, Lukrabo or **Ta-Fung-Tsze.**—The following article by Mr. E. M. Holmes appeared in the *Pharm. Journal,* 3rd Ser. XV., 41:—"In the interesting papers on 'Chinese Materia Medica,' by the late Daniel Hanbury, published in the *Pharmaceutical Journal* [2], Vol. III., a seed is described and illustrated under the name of *ta-fung-tsze,* which he conjectured to be allied to *chaulmugra.* This seed is largely used in China in skin diseases and leprosy, and is said to have been employed in that country for at least 300 years, since the tree affording the seed is figured in the old Chinese herbal 'Puntsaou,' published A. D. 1596. The tree, however, has up to the present time been unknown to botanists. The *ta-fung-tsze* is still an article of considerable commerce, figuring in the Consular Blue-Books under Chinese imports by the

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name of *lukrabo*. As much as 48 piculs (6,400 lbs.) of the seed were exported from Bankok to China in 1871. It is also exported thither from Saigon, in Cochin-China. The seed in question is about half the length of *chaulmugra* seed, but of equal diameter. The shell is thicker and harder, and at one end is marked with a few radiating slightly raised ridges, whereas that of *chaulmugra* is quite smooth.

"Dr. Porter Smith, in his 'Chinese Materia Medica' (1871), p. 140, describes these seeds under the name of *lucrubau*, and he also considers them as a variety of *chaulmugra*. He states that they are described in Chinese books as being good for leprosy, lepra, itch, pityriasis, psoriasis, syphilis, lipoma, vermes, and chaps on the back of the hands, and that calomel and the seeds of *Robinia amara* are used with the lucrubau, both externally and internally, in the treatment of leprosy. In the province of Hupeh the seeds are in great repute as a remedy for parasitic pediculi and the itch insect. In Soubeiran's "Matière Médicale chez les Chinois" (p. 221), the seeds are erroneously referred to *Gynocardia odorata*.

"In the Kew Report 1878, p. 30, the seeds under the name of *dai-phong-tu*, are said to be used in Saigon as a vermifuge after the extraction of the oil. It is added that M. Pierre has successfully raised some seeds of the plant, and refers it to the genus *Hydnocarpus*. The species, however, is not mentioned in the Kew Report, and no further information has appeared in it upon this point in subsequent years. Having had a specimen of the *lukrabo* seed in the Museum of the Pharmaceutical Society for some years—without a specific name—the author recently wrote to M. Pierre for information as to the species yielding the seed. In response that gentleman forwarded for the Society's herbarium a specimen of the plant with flowers and seeds, and the following interesting statement:—"It is a new species, which I have named *Hydnocarpus anthelmintica, Pierre*. It is very nearly allied to *H. alpina, Wight*, p. 940, but its leaves are more

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linear-oblong. The scales opposite to the petals are less long and more ciliated, the stigma is furrowed in its whole extent, and is only toothed towards the extremity of its reflexed margin, while in *H. alpina* it is furnished with large lobes. The male-flower contains a rudimentary ovary; in the female flower this is pyramidal. The seeds are used as a vermifuge by the Annamites. The names given in Annam to the plant are *dai-phong-tu* and *thaoc-phu-tu.* The specimen sent was gathered in the province of Bieṅ Hoa, in Southern Cochin-China."

HYDNOCARPUS WIGHTIANA, *Blume.*

Fig.—*Wight, Ill. i., t.* 16; *Rheede, Hort. Mal. i., t.* 36. Jungle almond (*Eng.*).

Hab.—Western Peninsula, South Concan to Travancore. The seeds.

Vernacular.—Kadu-kavatha (*Mar.*), Niradimutu (*Tam.*), Niradivittulu (*Tel.*), Tamana, Maravetti (*Mal.*).

History, Uses, &c.—All that we know of the history of this tree is that the seeds have long been used as a domestic remedy upon the Western Coast in certain obstinate skin diseases, and that the oil is expressed by the poorer classes for burning, and for use as a medicine. In scabby eruptions the oil mixed with an equal portion of *Jatropha Curcas* oil, sulphur, camphor and limejuice, is rubbed in. For scald head equal parts of the oil and lime-water are used as a liniment. The oil has also a reputation in the Concan as a remedy for *Bursati* in horses. Rheede tells us that it relieves rheumatic pains, is used in skin diseases, and mixed with ashes is applied to abscesses, sore eyes and wounds infected with maggots. (*Hort. Mal. i.*, 36.) In Travancore half-teaspoonful doses are given in leprous affections, and it is beaten up with the kernels and shells of castor seeds as a remedy for itch. Latterly the oil has been brought to the notice of

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Europeans as a substitute for Chaulmugra, and has been used in the Bombay Presidency with satisfactory results.

Description.—The fruit is globose, about the size of an apple; it has a rough, thick, brown rind, externally suberous, internally woody, which is generally studded with large tubercles, but non-tubercular fruit may be found on most trees. Within are from ten to twenty obtusely angular seeds, $\frac{3}{4}$ of an inch in length, embedded in a scanty white pulp firmly adherent to the thin black testa. When the pulp is scraped off, the outer surface of the testa is seen to be rough and striated by shallow longitudinal grooves; it has not the prominent ridges of *H. venenata*; *Gartn. Fruct. i., t.* 60. Inside the shell is a copious oily albumen, containing two large, plain, heart-shaped, leafy cotyledons like those of Chaulmugra. The albumen, when fresh is white, but turns of a dark brown colour in the dry seeds; the odour resembles that of Chaulmugra.

Microscopic structure.—The testa and albumen present the same appearance as those of the Chaulmugra seed.

Chemical composition.—The seeds contain about 44 per cent. of oil, which has an odour and colour similar to that of Chaulmugra oil; and a sp. gr. of 85° F. of ·9482. A large quantity in stock for more than 12 months did not give any crystalline fatty deposit. Treated with sulphuric acid the oil affords the gynocardic acid reaction, but in a less degree than Chaulmugra.

Commerce.—The seeds are not an article of trade, but if ordered, may be obtained at about half the price of those of Chaulmugra. The oil has been sold in Madras at As. 2-6 per seer.

BIXA ORELLANA, *Linn.*

Fig.—*Rumph., Amb II.*, 19; *Bot. Mag.* 1456. Annatto bush (*Eng.*), Rocouyer (*Fr.*).

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Hab.—America. Cultivated in India.

Vernacular.—Sendri, Kesri, Kesar-bondi (*Mar.*), Nutkaner (*Beng.*).

History, Uses, &c.—Bixa is the name given to this shrub by the American Indians; the Brazilian name is Urucuara, or the Urucu plant, Urucu being the Brazilian name for the pigment. There are two varieties, one with pink flowers and greenish-yellow fruit.

The plant does not thrive without plenty of sun.

The pigment is prepared by macerating the seeds in water, straining to remove seeds and evaporating to a suitable consistence; the mass is then made into *roll* or *flag Annatto.* The seeds simply dried with the pigment on them are called *Urúcu em gros.* Urucu is used by the American Indians as a dye and for colouring food. A hot infusion of the leaves is considered to be a remedy for jaundice. (*U. S. A. Consul's Rep. on Annatto.*) Annatto is also used by Caribs to dye their bodies; and in Europe to colour butter, cheese and varnish. The use of annatto in dyeing cloth is now limited, *aurin,* an aniline dye, being used for the production of orange colours.

The pulp surrounding the seeds is astringent and slightly purgative. (*Roxb.*) The seeds and root are cordial, astringent and febrifuge. (*Rumph.*) The plant thrives in India and is cultivated in many parts of the country. It is the Galuga of Rumphius (II. 28), who notices its use in Amboyna as a paint and dye.

Chemical composition.—The colouring matter contained in the seeds may be obtained in the form of minute red leaflets (Bixin $C^{28} H^{34} O^{5}$) insoluble in water, slightly soluble in alcohol, but easily dissolved by ether.

Bixin dissolves in concentrated sulphuric acid, the solution being of a bright blue colour; diluted with water it yields a green precipitate.

COCHLOSPERMUM GOSSYPIUM, *DC.*

Fig.—*Wight in Hook. Bot. Misc. ii.*, 357; *Suppl., t.* 18. Golden Silk-cotton tree (*Eng.*).

Hab.—Garwhal, Bundelkhund, Behar, Orissa and Deccan. The gum.

Vernacular.—The tree, Pili-kapas (*Hind.*), Tanaku (*Tam.*), Konda-gogu (*Tel.*). The gum, Katíra-i-Hindi (*Pers., Hind.*).

History, Uses, &c.—This tree grows upon dry hilly ground, where it attains a large size. The flowers are large and of a golden yellow colour, and appear in March and April, when the tree is destitute of leaves; the capsule is the size of a goose egg and filled with cotton; the seeds kidney-shaped or cochleate, with a hard testa. The gum is used in the Upper Provinces as a substitute for Tragacanth. The Katíra, or more correctly Kathíra of Arabic and Persian writers on Materia Medica, is the true Tragacanth, and the name has been transferred to the gum of this tree by the Mahometan settlers in India. In Celebe the seeds are roasted and eaten; they are sweet and oily; the young leaves are used to make a cooling wash for the hair. (*Rumph.*, I. 80.) In Bombay the gum of *Sterculia urens*, called 'Karai gond' by the Guzerathi shopkeepers, is used as country Tragacanth, and is sold by Mussalman druggists as Katíra.

Description.—White or yellowish, generally in large vermicular pieces, transversely fissured, and showing a tendency to split up into flat scales, sometimes in large flat pieces like Tragacanth; when moistened it swells up into a bulky transparent jelly, which may be diffused in a large quantity of water, but is only very sparingly soluble. Its solution in water is neutral; the portion insoluble in water yields with alkalies a thick mucilage of a pinkish colour, which, according to Mitchell (1880), is not precipitated by acids.

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FLACOURTIA CATAPHRACTA, *Roxb.*

Fig.—*Rumph. Amb., Cap.* 43, *p.* 38; *XIX., t.* 1, 2. Many-spined Flacourtia (*Eng.*), Prunier d' Inde (*Fr.*).

Hab.—India. Commonly cultivated. The fruit.

Vernacular.—Pani-aonvála (*Hind.*), Jaggam (*Port.*), Tambat (*Mar.*), Paniála (*Beng.*).

History, Uses, &c.—This is the Práchinámalaka of Sanskrit writers; it appears to be doubtful whether it is a native of India, as it is generally met with in a cultivated state. The author of the Makhzan-el-Adwiya speaks of two kinds of Paniála, one cultivated and the other wild. He describes the fruit as being like a plum, but differing from it in having 5 to 6 stones instead of one, and suggests that this difference may be due to the impurity of the atmosphere of Bengal operating upon the plum tree of Persia. The Bombay name Jaggam appears to be a corruption of Jangomas. Dalzell and Gibson consider the tree to be truly wild in the Southern Concan. The fruit is recommended as useful in bilious conditions; and like most acid fruits, it no doubt relieves the nausea and checks purging. It is the size of a plum, purple, and acid; indehiscent, with a hard endocarp; seeds 5 to 6, obovoid; testa coriaceous; cotyledons orbicular.

F. Ramontchi, L'Herit., the Mauritius plum, and *F. sepiaria, Roxb.*, have similar properties. None of these plants are of any importance medicinally, nor are they worth cultivating as fruit trees. Their bark and leaves are acid and astringent, and are sometimes used by the natives both internally and externally. The leaves of *F. Cataphracta* are oblong or oblong-lanceolate, long-acuminate, glabrous, crenate-serrate, 2—4 by 1—1¾ inches; they have a short petiole from ¼ to ½ an inch in length. An oil is extracted from the seeds on the Malabar Coast.

PITTOSPOREÆ.

PITTOSPORUM FLORIBUNDUM,

W. & A. var.

Hab.—Subtropical Himalaya, Western Peninsula.

Vernacular.—Vehkali, Vikhári, Vehyenti (*Mar.*), Tibiliti (*Nepal.*).

History, Uses, &c.—Little or nothing appears to be known of the medicinal properties of the genus Pittosporum. A variety of *P. floribundum* is common on the Western ghauts and in other mountainous parts of India. The bark is bitter and aromatic, and is said by the natives to possess narcotic properties. It is used as a febrifuge in doses of 5—10 grains; in doses of 20 grains they believe it to be a specific for snake poison. The Maratha's on the Ghats call it Vikhari or Vishári, which means "an antidote for poison." Mr. Bajaba Balaji Nené, a Brahmin practitioner of Poona, who first noticed its use among the hill people, informs us that he has given 5—10 grain doses of the dried bark with benefit in chronic bronchitis, and that he finds it to be a good expectorant, but in one or two cases in which it was tried in Bombay, it is said to have given rise to dysenteric symptoms; Mr. Nené, however, informs us that he has not observed its administration to be followed by any such effect. Graham remarks that the cortex fetidus of Rumphius (vii., 7,) appears to belong to this genus.

Description.—The bark is in single hard quills of various sizes, the external surface is grey and marked by numerous transverse ellipsoid warty prominences, which often form circular rings; the inner surface is very smooth and of a light brown colour when dry; fracture short, granular; odour aromatic and resembling that of caraways; taste sub-aromatic and very bitter. *P. floribundum* is a small tree, branches

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often umbelled; leaves lanceolate or oblong-lanceolate, acute or acuminate, margins waved 2—8 by 1—3 inches, glabrous, shining, pale below, coriaceous. Corymbs terminal, branches 1—3 inches, spreading; glabrous or pubescent. Flowers few or numerous, yellow; sepals obtuse or acute, subciliate; style glabrous. Capsules size of a large pea, glabrous, about 6-seeded, opening round the apex; seeds covered with a reddish resinous substance. Graham considers the *P. floribundum* of Western India to be very near to if not identical with *P. undulatum, Vent.*, of N. S. Wales, called by the English colonists Native Laurel and Mock Orange, from the bark of which Baron Mueller and L. Rummel have obtained a bitter glucoside which they have named Pittosporin. (*Cf. Wittstein Org. Const. of Plants.*) The Indian plant yields a similar principle, as well as an aromatic yellow resin or oleo-resin having very tenacious properties.

POLYGALEÆ.

A plant named πολυγαλον was known to the Greeks and Romans, and is mentioned by Dioscorides and Pliny; it is generally identified with the *Polygala vulgaris, Linn.*, the Milkwort of the English and Laitier of the French. Dodoneus calls it "*Flos ambarvallis*," or, "the flower which goes round the fields," because, says Gerarde, "it doth especially floure in the Crosse or Gang weeke, or Rogation weeke; of which floures the maidens which use in the countries to walk the Procession, do make themselves garlands and nosegays; in English we may call it Crosse-floure, or Procession-floure, Gang-floure, Rogation-floure, and Milkwort." *P. vulgaris* is bitter, acrid, and somewhat aromatic, especially the root; it acts as an expectorant, tonic, and purgative, and still retains a reputation in Europe as an expectorant in chronic bronchial catarrh. Several species of Polygala are used on account of their possessing similar medicinal properties, the best known being the *P. Senega* of America. In the East *P. tenuifolia* is the Yuen-chi of the Chinese. Smith (*Chinese Mat. Med.*, p. 175) says that the root is brought from Shensi and Honan, and is used in cynanche, cough, and carbuncle, and the leaves in spermatorrhœa. In India, *P. crotalarioides, Ham.* (*Royle Ill. t.* 19. C.), a plant of the temperate Himalaya from Chamba to Sikkim, and of the Khasia mountains, has a reputation as an expectorant.

P. telephioides, *Willd.*, growing in the Western Peninsula, has a similar reputation.

P. chinensis, *Linn.*, is common in pasture lands throughout India in the rainy season. It is called Merádú in Hindi and Négli in Marathi; and is not used medicinally. A species of *Polygala* is the Furfur of the Persians and Lubánat of the Arabians.

Like Senega all these plants owe their medicinal properties to the presence of a substance closely related to, if not identical with, saponin.

CARYOPHYLLEÆ.

SAPONARIA VACCARIA, *Linn.*

Fig.—*Mor. Ox.* 5, 21, 27. *Syn.*—Gypsophila Vaccaria. Perfoliate Soapwort (*Eng.*).

Hab.—Wheat fields throughout India and Central Europe. The root.

Vernacular.—Sábúni (*Hind., Beng.*).

History, Uses, &c.—The root of a plant named στρουθίον was used by the Greeks for washing wool on account of its saponaceous qualities. (*Theoph. H. P. vi.* 4, 3; *Dios. II.*, 152.) This root was also used medicinally. (*Hipp. pag. Fœs.* 571, 54; *Dios., II.*, 152.)

The Romans used the same root under the names of Struthium and Radicula. Pliny (19, 18 and 24, 58) tells us that it is diuretic, laxative, and sternutory, and was prescribed

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in jaundice, cough, liver, spleen, asthma, and pleurisy; that on account of its supposed detergent action on the uterus, it was called "aureum poculum," and was also applied externally with meal to resolve tumours, &c. Struthium has been identified by some with *S. officinalis*, *Linn.*, and by others with *Gypsophila Struthium*, *Linn.*, both of them plants having properties identical with *S. Vaccaria*, which is also a European plant. The Arabs are acquainted with the soapworts under the name of El-sábuniyeh.

Boerhave and the physicians of his time employed *S. officinalis* on account of its supposed resolvent and alterative action in syphilis, Barthez in gout, and Biett for chronic skin diseases. Lebœuf, of Bayonne, was the first to discover the emulsifying properties of saponin and of tinctures of those drugs which contain it, such as Senega, Quillaya, &c.

The physiological action of saponin is that of a powerful sternutatory; injected subcutaneously it greatly irritates the tissues; Pélikan has shown that it exerts upon the motor and sensatory nerves a benumbing action approaching to paralysis. Köhler has observed that it paralyses the motor centres of the nerves of respiration and circulation. According to Schroff it augments the bronchial secretions and acts as a diuretic and purgative. The supposed emmenagogue action of the soapworts has not been proved. As a medicine, saponin has not as yet been tried, but drugs which doubtless owe their activity to its presence have been long in use in India and elsewhere.

Description.—*S. Vaccaria* is a tall, robust, simple or sparingly branched, perfectly glabrous annual, with oblong-acute leaves, and linear-oblong cauline leaves. The flowers are in dichotomous cymes, and of a pink colour. The taste of the entire plant is bitter and saline. The roots are very long and cylindrical, branching, and about the size of a quill, bark externally reddish, thick, and easily separable; internally firm and white.

Chemical composition.—An infusion of the root is blackened by salts of iron, and its decoction froths like soap and water.

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The powdered root exhausted with boiling alcohol yields saponin, which is deposited on the cooling of the alcohol. Saponin is a white, amorphous, friable, inodorous substance, having an acrid taste. It is very soluble in water, and forms with it an emulsion. It is insoluble in ether, soluble in weak spirit and in boiling absolute alcohol. Treated with an acid and its solution boiled, saponin is converted into sapogenin and sugar—

$$C^{32} H^{54} O^{18} + 2 H^{2} O = C^{14} H^{22} O^{2} + 3 C^{6} H^{12} O^{6}.$$

Sapogenin is soluble in alcohol and ether, and crystallizes from the former by slow evaporation in concentric groups of needles. From solution in dilute aqueous potash it is precipitated by stronger potash-ley, as flocculent potassium sapogenin; the solution in alcoholic potash is precipitated by water only when the potash is in excess. When sapogenin is heated with potassium hydrate till decomposition commences, part of it is resolved into acetic acid, butyric acid, and a soft brown substance, and the undecomposed portion when separated by potash melts at 128°, whereas before the treatment with potash it does not liquefy at that temperature. The compound obtained by Fremy from saponin and designated as æsculic acid, is regarded by Rochleder as $C^{26} H^{42} O^{12}$, and its formation is represented by the equation—

$$C^{32} H^{54} O^{18} = C^{26} H^{42} O^{12} + C^{6} H^{12} O^{6}.$$

Christophson (*Archiv. d. Pharm. VI.*, 432, 481), obtained from *Gypsophila Struthium* root 14·59, 15·0, 13·31, and 13·2 per cent. of saponin; and from *Saponaria officinalis* root 4·78 and 5·09 per cent.

DIANTHUS ANATOLICUS, *Boiss.*

Hab.—Western Tibet to Armenia.

Vernacular.—Kanturiyun (*Pers., Ind.*).

History, Uses, &c.—This plant has been introduced into the Materia Medica of the East as a substitute for

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Erythrœa Centaurium, Pers., the Centaury of the British Flora, which it only resembles in having pink flowers. *D. anatolicus* is a densely-tufted plant, with a much-branched, short, woody stock; stems 6 to 10 inches, very slender, strict, one or more flowered; leaves rigid, slender, with a very thick midrib and margin; bracts with sometimes foliaceous points; calyx teeth subacute; petals rosy, blade small, broad, crenate-toothed. The plant contains a little saponin. It is imported from Persia *viâ* Bombay.

Polycarpæa corymbosa, *Lam., Ill.* 2798; *Wight Ic., t.* 712. A small plant found in many parts of India from the Himalaya to Ceylon, is administered in Pudukota both externally and internally as a remedy for the bites of venomous reptiles. Its Tamil name is Nilaisedachi. It may possibly contain a little saponin, but we have not thought it of sufficient importance to be examined.

PORTULACEÆ.

PORTULACA OLERACEA, *Linn.*

Fig.—*Plant. Grass.* 123; *Rheede, Hort. Mal. x.*, 36. Purslane (*Eng.*), Pourpier potager (*Fr.*).

PORTULACA QUADRIFIDA, *Linn.*

Fig.—*Jacq. Col. II., t.* 17, *f.* 4; *Rheede, Hort. Mal. x.*, 31.

Hab.—All warm climates.

Vernacular.—Lonia (*Hind., Beng.*), Kurfáh (*Pers*), Bhuigholi (*Mar.*), Passelie Keeray (*Tam.*), Loni (*Guz.*).

History, Uses, &c.—The creeping annual Purslane has probably been long used as a domestic remedy by the Hindus. The Sanskrit names are Loniká and Lonámla. The fresh leaves are acid, and are prescribed when bruised as a cooling external application in erysipelas, and an infusion of them is given as a diuretic. In Arabic and Persian works the herb is

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called Baklat-el-humaka or Baklat-el-mubarika and Kurfah; two kinds are described, the large and the small. The former is probably *P. oleracea*, as its use as a vegetable is noticed. Both kinds are said to be cold and moist, and to have detergent and astringent properties. Portulaca is the ανδραχνη of Dioscorides (ii., 113), and is mentioned by Celsus (2, 33), who calls it Portulaca. Macer says:—

> *Andrachne Græcis quæ portulaca Latinis*
> *Dicitur, hæc vulgi* pes pulli *more vocatur.*

(*Pulli pes, i.e.*, poulpied, whence the modern name pourpier.) The plant and seeds are recommended in a great many diseases of the kidneys, bladder, and lungs, which are supposed to be caused by hot or bilious humours. They are also praised as an external application in burns, scalds, and various forms of skin disease. Ainslie mentions *P. quadrifida* and *P. oleracea* as being used in Southern India by Tamil physicians. These herbs can be obtained in most vegetable markets, and the seeds of *P. oleracea* are kept in druggists' shops. In Guadaloupe, *P. pilosa, Linn.*, is known as pourpier amer or quinine-pays, on account of its bitter and febrifuge properties. It is best administered in the form of a tincture composed of Bitter purslane 100 parts, Rum 150 parts, Bordeaux wine 850 parts, Citrate of iron 5 parts. Dose 60—100 parts.

Description.—The two Portulacas, called Barra and Chota Lonia in Hindustani, may be readily recognised by their low growth, succulent, flat or nearly cylindrical leaves, and small yellow flowers (in *P. quadrifida* there are tufts of bristles in the axils), the seeds are black, minutely tubercled, and kidney-shaped; those of *P. oleracea* are much the largest. The leaves contain acid potassium oxalate and mucilage.

TAMARISCINEÆ.

TAMARIX GALLICA, *Linn.*

Fig.—*Wight. Ill.*, t. 24 *A.*; Var. ramosissima, *Ledeb. Ic. Fl. Ross.*, *t.* 256. Tamarisk (*Eng.*), Tamarisc de France (*Fr.*).

Hab.—Asia, Europe, Africa. The galls and manna.

Vernacular.—The galls, Barrí Main (*Hind.*), Samrat-ut-Turfah (*Arab.*), Magiya-main (*Bomb.*), Gazbar, Gazmázú (*Pers.*); the manna, Gazangabín and Gazanjabín (*Arab., Pers., Ind.*).

History, Uses, &c.—This small tree or bush is widely distributed in Europe, Africa, and Asia. Dioscorides, speaking of μυρίκη says that in Egypt and Syria it bears a seed like a gallnut, which is used as an astringent. (I., 101.) Pliny calls the same tree Tamarica (24, 41). It is the Tamarix of Columella (8, 15). Nicander calls the Tamarix μάντιν (prophetic). The Apollo of Lesbos is represented with a branch of the tree in his hand. The Persian Magi also prophesied with a branch in their hands. Herodotus and Pliny mention a similar use of the Tamarix. In Sanskrit it is called Jhávuka, and in Hindustani Jhau. The galls have probably long been used in Northern India as a substitute for the true gall. The manna is not produced in India, but in Persia and Arabia; in the month of June it drops from the tree, and is collected. In Persian works the galls of the Tamarix are called the fruit, and the manna is described as a dew which falls upon this and other trees, notably the willow and oak, and becomes solidified. The Hakíms consider the manna to be detergent, aperient, and expectorant. It is probably the δροσόμελι of Galen. In modern medicine manna is still used as a laxative; it slightly increases the action of the bowels, causing more frequent and softer stools without irritation. Its sweet taste makes it acceptable to children. The galls like those of the oak contain tannic and gallic acids, and may be used as an astringent in the same manner as true galls. (*See* Quercus.)

Description.—The galls are much smaller than true galls, 3-angled, and knotty; in the centre is a cavity which sometimes contains the fly, but generally only excrementitious matter. The manna occurs in small grains, which are nearly white when fresh, but in this climate have a tendency to liquefy and form a thick yellow fluid like honey; it is produced upon Tamarisk, willow and oak, in consequence of

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the puncture of an insect. According to Ehrenberg, the insect which attacks the Tamarisk is the *Coccus manniparus*. The name Gazangabín signifies Tamarisk-honey, and is used, according to Haussknecht, at the present time in Persia to designate a manna collected in the mountain districts of Chahar-Mahal and Faraidan from two species of Astragalus (*confer. Pharmacographia*, p. 371). This account agrees with that found in Persian works on Materia Medica, which describe Gazangabín as the produce of several trees. Rich (*Residence in Koordistan*, Vol. I., p. 142,) describes the collection of Gazangabín, called by the Koords *Ghezo*, by picking the leaves of the trees, letting them dry, and then gently threshing them over a cloth. The season commences about the end of June. Aitchison states that in Khorasan it is produced by *Cotoneaster nummularia, Fisch. et Mey.**; the shrub is called Siyah-chub, and is very abundant upon the Siyah-Koh and Sufed-Koh hills and in the Ardewán Pass, forming thickets: the manna forms in July and is shaken into a cloth.

Chemical composition.—Tamarisk manna from Sinai, examined by Berthelot, was a thick yellow syrup, and was found to consist of cane sugar, inverted sugar (levulose and glucose) dextrin and water, the last constituting one-fifth of the whole. A specimen of Persian Gazangabín yielded to Ludwig, dextrin, uncrystallizable sugar and organic acids. The galls contain as much tannic acid as oak-galls and are readily purchased by manufacturers when offered for sale in Europe.

Commerce.—Gazangabín is imported into Bombay from Persia. Value Re. ½ per lb.; it is kept in most druggists' shops. The galls are sometimes abundant; at others unobtainable. Value, Rs. 12 to 13 per maund of 37½ lbs.

Tamarix articulata, *Vahl. Symb. ii.*, 48, *t.* 32. The galls.

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* The leaves found in the Gazangabin imported into India are certainly those of Cotoneaster, as may be seen by a comparison with Aitchison's figure. (*Trans. Linn. Soc., 2nd Ser. Botany, Vol. III., Pt. I.*, 9.)

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Vernacular.—Chotí Main (*Hind.*), Samrat-el-Asl (*Arab.*), Magiya-main (*Bomb.*), Gazbar and Azbah (*Pers.*). The tree is abundant in Sind and the Punjab, and is often cultivated. The galls are made use of as a substitute for true galls, a description of their properties and uses will be found in Arabic and Persian works under the name of Sumrat-el-Asl; these do not appear to differ in any important particular from the uses to which common galls are applied. These galls are smaller than those of *T. gallica*, and are not 3-angled; they are round, knotty, of the size of a pea, and of a yellowish brown colour. Small Tamarisk galls are occasionally offered in the market in large quantities, but are often not obtainable. Value, Rs. 12 to 13 per maund of 37½ lbs.

HYPERICINEÆ.

A number of species of Hypericum are found in the hilly parts of India, chiefly in the North, where *H. perforatum, Linn.*, is recognised by the Mahometans as representing the ὑπέρικον or ἀνδρόσαιμον of the Greeks. In Persia a plant, described by Mahometan writers on Materia Medica as a species of Hyufárikún (Hypericon) is known by the local names of Dádi and Jau-i-jádú or "magic barley." To these plants are ascribed the medicinal virtues which were formerly attributed to the St. John's worts of Europe; the old name of which was Fuga Dæmonum, in allusion to their supposed power of expelling the demon of hypochondriasis. Hypericum was also thought to act as a charm against witchcraft. On account of the red juice of the flowers, which was considered a signature of human blood, it was called ἀνδρόσαιμον by the Greeks, and was used as an application to wounds. The *Hypericum Androsæmum* of the botanists is the large bushy plant, so common in shrubberies in England, it is the Toute saine of the French, the Tutsan of the English, and the Rumman-el-anhar of the Arabs. By some it is considered to be the Hypericon of the Greeks. These herbs are bitter and astringent, and were formerly supposed to have detersive, resolutive, anthelmintic, diuretic and emmenagogue properties when given internally. Externally they were used as vulneraries, and as excitants in chronic rheumatism. They are not used in modern medicine.

Chemical composition.—When the flowers of *H. perforatum*, freed from their calices and dried, are exhausted with absolute alcohol, and the tincture is evaporated, a soft residue is left of a red colour (hypericum red) together with volatile oil. If the flowers are exhausted with water, then with dilute alcohol, well dried after exhaustion, and the colouring matter extracted from them by ether, it remains on evaporation as a blood-red resin, having an odour of chamomile. It melts below 100° and does not yield ammonia by dry distillation. It is insoluble in water and in dilute acids. By aqueous ammonia, potash and soda, it is coloured green and dissolved; the saturated solution is red by reflected light, but exhibits after dilution a green colour by transmitted light. The ammoniacal solution leaves on evaporation a neutral blood-red resin having the odour of hypericum, soluble with yellow colour in water, and giving off ammonia when treated with potash. The red combines also with the alkaline earths, earths proper, and heavy metallic oxides; its alcoholic solution precipitates the alcoholic solution of chloride of calcium, also neutral acetate of lead and ferric chloride. It dissolves in alcohol, more readily in ether, with wine-red to blood-red colour, also in volatile oils and in warm fixed oils. (*Buchner.*) According to Marquart, the colouring matter of the fresh flowers is a mixture of anthocyan and anthoxanthin, separable by exhausting with alcohol and treating the residue with water.

GUTTIFERÆ.

GARCINIA INDICA, *Chois.*

Fig.—*Bent. and Trim.*, *t.* 32; *Wight. Ill. I.*, 125. Red Mango (*Eng.*), Garcinia a fruit acide (*Fr.*).

Hab.—Western Peninsula, Amboyna. The fruit, seeds, and bark.

Vernacular.—The fruit, Ratámbi, Bhirand (*Mar.*), Brindao (*Goa*); the oil, Kokam cha tel, Bhirandel (*Mar.*); the bark, Ratámbi sála (*Mar.*).

History, Uses, &c.—The tree is common on the Western coast between Damaun and Goa; it grows wild upon the hills of the Concan, but is often to be seen in gardens close to the sea. It flowers about Christmas, and ripens its fruit in April and May. The fruit is largely used all along the Western coast as an acid ingredient in curries, and is an article of commerce in the dry state. It is generally prepared by removing the seeds and drying the pulp in the sun: the latter is then slightly salted and is ready for the market. It is known as *Amsul* or *Kokam*, and was in use in the Bombay Army as an antiscorbutic in 1799. (*Dr. White.*)* In Goa the pulp is sometimes made into large globular or elongated masses. The seeds are pounded and boiled to extract the oil, which, on cooling, becomes gradually solid and is roughly moulded by hand into egg-shaped balls or concavo-convex cakes. This is the substance known to Europeans as *Kokam butter.* The natives occasionally use it for cooking, but it is mostly valued on account of its soothing properties when used medicinally. The juice of the fruit is sometimes used as a mordant in dyeing, and the apothecaries of Goa prepare a very fine red syrup from it, which is used in bilious affections. Nothing seems to be known of the history of the Kokam fruit before the time of Garcia d'Orta (1563), who found it in use at Goa, under the name of Brindão,† when he visited that city; the same name is still used by the native Christians. As it was an article of export in Garcia's time, there can be little doubt that it was used in Western India long before the Portuguese visited the country, just in the same manner as it is at the present day. The tree was known to Rumphius, who calls it Folium acidum majus or Groot Saur-

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* MS note signed by him in the Bombay Asiatic Society's copy of Rumphius.

† A corruption of the Marathi name भिरंड Bhirand.

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blad. He says the young leaves are acid like sorrel, and are used in cooking fish in Amboyna. Kokam butter appears to have first attracted the notice of Europeans about 1830 as a remedy for excoriations and chaps of the skin; in order to apply it, a piece is partially melted and rubbed upon the affected part. It is also of great value for the preparation of Nitrate of Mercury ointment, which if made in the usual manner is too fluid for hot climates; Indian lard being very fluid, equal parts of it and Kokam oil will be found to make an ointment of good consistence and colour which keeps well. The bark is astringent, and the young leaves after having been tied up in a plantain leaf and stewed in hot ashes, are rubbed in cold milk and given as a remedy for dysentery.

Description.—The fruit is spherical, about the size of a small apple, red, containing an acid pulp of a still deeper colour, in which from 5 to 8 reniform seeds are embedded; the seeds are compressed laterally, wrinkled, about ¾ of an inch long by 4-10ths broad; the cotyledons are very thick, closely adherent, and have a sweet oily taste. Kokam butter is of a yellowish white colour, firm, dry and friable in the hottest weather, and greasy to the touch like spermaceti; its structure is crystalline; it generally contains impurities, and requires to be remelted and strained before it can be used for pharmaceutical purposes; the residue after this process consists chiefly of particles of the fruit and seed.

Microscopic structure.—The cotyledons are composed of large reticulated cells containing crystalline fat.

Chemical composition.—Flückiger and Hanbury give the following account of it:—"Purified Kokum butter, boiled with caustic soda, yields a fine hard soap, which, when decomposed with sulphuric acid, affords a crystalline cake of fatty acids weighing as much as the original fat. The acids were again combined with soda, and the soap having been decomposed, they were dissolved in alcohol of about 94 per cent. By slow cooling and evaporation, crystals were first formed, which, when perfectly dried, melted at 69·5° C.; they

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are consequently Stearic acid. A less considerable amount of crystals which separated subsequently had a fusing point of 55° C., and may be referred to Myristic acid. A portion of the crude fat was heated with oxide of lead and water, and the plumbic compound dried and exhausted with ether, which after evaporation left a very small amount of liquid oil, which we refer to Oleic acid. Finally the sulphuric acid used at the outset of the experiments was saturated, and examined in the usual manner for volatile fatty acids (butyric, valerianic, &c.), but with negative results.

"The fat of the seeds of *G. indica* was extracted by ether and examined in 1857 by J. Bonis and d'Oliveira Pimentel. It was obtained to the extent of 30 per cent., was found to fuse at 40° C., and to consist chiefly of stearin (tristearin). The seeds yielded 1·72 of nitrogen. Their residue after exhaustion by ether afforded to alkaline solutions or alcohol a fine red colour." The dried fruit sold in the bazaar as kokam has been examined by Lyon (1881) with the following results:—Moisture, 37·04; hot water extractive, 42·90; cellulose, 5·52; insoluble residue, 14·54. Hot water solution bright red and very acid, turns bluish green on addition of alkalies in excess; acidity due to Malic acid. Tartaric acid either absent or traces only present. No Citric acid. Fixed free acidity = 13·537 per cent. Malic acid. Total ash 7·88. Insoluble in water 1·96; soluble in water 5·92. Chlorine of soluble ash as Na Cl = 4·62 per cent. Alkalinity of soluble ash as potash = 0·79 per cent. The Chloride of Sodium is probably introduced when the kokam is salted.

Commerce.—The dried fruit comes from Goa, Hingoli and Malwan. Value, Rs. 40 per candy of 28 Bombay maunds of 28 lbs. each.

Kokam butter comes from Goa. Value, Rs. 5 to 7 per Surat maund of 37½ lbs.

Garcinia Zanthochymus, *Hook. f.*, *Roxb. Cor. Pl. II.*, 51, *t.* 196. A tree of Eastern Bengal, Eastern Himalaya, Eastern Peninsula, Western Peninsula, produces a yellow fruit the size of a small apple and very acid, which is used for the same purposes as that of *G. indica*; it is dried and made into a kind of Amsúl. In bilious conditions a sherbet made with about 1 oz. of the amsúl with a little rocksalt, pepper, ginger, cummin and sugar, is administered. The native name is Onth. or Osht.

GARCINIA MANGOSTANA, *Linn.*

Fig.—*Bot. Cab.* 845. Mangosteen (*Eng.*), Mangostan (*Fr.*). The rind.

Vernacular.—Mangustan (*Ind.*).

Hab.—Malayan Peninsula, Southern Tenasserim.

History, Uses, &c.—The rind, or entire fruit dried, of the well-known mangosteen is brought to India from the Straits and Singapore, and is a popular remedy for diarrhœa and dysentery. Rumphius tells us that the Macassars also use the bark and young leaves for the same purpose and to cure aphthæ of the mouth. Dr. S. Arjun, of Bombay, has found the rind very useful in the chronic diarrhœa of children. It has also been used as a febrifuge. The medicinal action of this drug appears to be chiefly due to the tannin which it contains (*see* Quercus). The physiological effects of the crystallizable substance mangostin and of the resin have not been studied, but the drug may probably be classed with the terebinthinate astringents.

Description.—The fruit is globular, as large as a small apple, with a thick woody rind: it is crowned by the calycine segments, which form a kind of rosette: within it is a sweet acidulous white pulp and several seeds. The thick rind and the bark of the tree are very astringent, and yield an astringent extract which may be given in pills or syrup.

Chemical composition.—W. Schmidt has obtained a crystallizable substance, *Mangostin*, $C^{20} H^{22} O^{5}$, from the rind of the

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fruit. To obtain it the rind is first boiled in water to remove tannin, and afterwards exhausted by boiling alcohol; upon evaporation of the alcoholic extract, a yellow amorphous mass is obtained, which consists of mangostin and resin; this is redissolved in boiling alcohol, and water added to the boiling solution as long as it causes a precipitate of resin. From the solution on cooling mangostin is obtained in small yellow scales; it may be purified by resolution in alcohol and precipitation by subacetate of lead; remaining traces of resin are removed by the addition of water to the alcoholic solution, and finally, after several recrystallizations from weak alcohol, the mangostin is obtained in thin golden yellow scales, which are tasteless, and fuse at about 190° C.; at a higher temperature it is decomposed, a portion subliming unchanged. Mangostin is insoluble in water, but readily soluble in alcohol and ether; its solutions are neutral, hot dilute acids dissolve it without change, hot concentrated nitric acid converts it into oxalic acid, sulphuric acid forms with it a deep red solution and chars it if heated. It forms yellow solutions with alkalies. It reduces solutions of the noble metals, and turns perchloride of iron of a dark green colour, which is removed by the addition of an acid. (*Ann. der Chem. und Pharm.*, t. xciii., p 83; *Wurtz; Dict. de Chim.*, t. ii., p. 310.)

GARCINIA MORELLA, *Desrouss.*

Fig.—*Bentl. and Trim.*, *t.* 33; *Wight Ic.*, *t.* 102. Gamboge tree (*Eng.*), Guttier des peintres (*Fr.*).

Hab.—Eastern Bengal, Western Peninsula, Eastern Peninsula, Ceylon. The gum-resin.

Vernacular.—The tree, Makki-maram, Korakapuli (*Tam.*), Jarigehulimara (*Can.*), Tamál (*Hind.*, *Beng.*, *Mar.*). The juice, Tamál (*Hind.*, *Beng.*, *Mar.*, *Can.*) The drug Gamboge, Ussáreh-i-Rewand, Gotaganba (*Pers.*, *Ind.*), Revanchi-no-siro (*Guz.*).

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History, Uses, &c.—The Gamboge tree of Malabar and Canara, which is also found in other parts of India, is by Beddome called *G. pictoria* and kept distinct from *G. Morella.* Hooker considers them both to be the same species. There would seem to be no doubt that Gamboge has never been collected in India as an article of commerce; and that it is only from a comparatively recent date that the drug has been known in this country; but the Hindus of Canara and Mysore, and probably of other parts of India, have for a long time used the juice of this tree under the Sanskrit name of Tamála as a pigment for making sectarial marks on the forehead, and this name is still current in Hindi, Bengali and Marathi. Other Sanskrit names for the tree are Tápiccha and Tápinja. The Ussárah-i-Rewand of Arabic and Persian books is, properly speaking, an extract of Rhubarb, as the name implies, but owing to a similarity in properties and also in colour, the same name was applied to Gamboge upon its becoming known as an article of commerce. Siam Gamboge is the only kind obtained in the drug markets. An interesting account of the history of commercial Gamboge will be found in the *Pharmacographia* from which it appears that it only became known to the Chinese about A.D. 1300, and was not introduced into Europe before 1603. Reudenius (1614—1625) described its medicinal properties and recommended its use as a purgative in arthritis (gout).

Description.—Through the kindness of Dr. Davies, when Civil Surgeon in Canara, we received a specimen of Gamboge collected there. It is in irregular fragments, and appears to have been collected upon leaves, portions of which still adhere to it. The finer pieces have the colour and consistence of Siam Gamboge, but contain many impurities, such as portions of wood and leaves. Fully half the sample is of a dirty yellowish brown colour, and has a spongy structure; this portion, treated with rectified spirit, gives a clear deep orange solution like ordinary Gamboge, but leaves a copious greenish yellow marc, which appears to be chlorophyll. As at present collected, this Gamboge is too impure for commercial purposes.

Chemical composition.—Indian Gamboge has been found by Christison (1846) to be essentially the same as that of Siam. It has also been examined by Broughton (1871), who is of opinion that it is equal to that of Siam. A sample of Gamboge from the Nagar district in Mysore was found by one of us to be remarkably pure; it had the following percentage composition:—Moisture, 5·4; resin, 80·4; gum, 13·0; dross, 1·2.

Commerce.—In the Indian markets the ordinary pipe Gamboge is alone met with. Price, Re. 1¼ per lb.

MESUA FERREA, *Linn.*

Fig.—*Rheede, Hort. Mal. iii.*, 53; *Wight Ill.*, *t.* 127; *Ic. t.* 118. Iron wood tree (*Eng.*), Mésua Naghas (*Fr.*).

Hab.—E. Bengal, E. Himalaya, E. and W. Peninsulas, Andamans. The flowers.

Vernacular.—Nágkesar (*Hind.*, *Beng.*), Nágchampa (*Mar.*), Nagecuram (*Tam.*), Naga-sampagi (*Can.*), Chikati manu (*Tel.*), Veila (*Mal.*)

History, Uses, &c.—This beautiful tree, with its large Cistus-like white flower, called in Sanskrit Kanjalkama and Nágkesara, is a favourite of the Indian poets. In the Naïshada the poet compares the petals of the flowers from which the bees were scattering the pollen of its golden anthers, to an alabaster wheel on which Kamadeva was whetting his arrows, while the sparks of fire were dispersed in every direction. It is the *Castanea rosea indica* of Rheede, so called, because the fruits are like chestnuts in size and shape. The dried blossoms are prescribed by Hindu physicians as an adjunct to medicinal oils on account of their fragrance, and are also considered to have astringent and stomachic properties. Powdered and mixed with *ghi* (liquid butter) they are recommended by most of the later Hindu writers in bleeding piles, and burning of the feet. The root bark of *Mesua ferrea* contains

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much resinous juice, which exudes freely when it is wounded; it has a reddish brown epidermis, consisting of ten or more rows of brick-shaped cells, full of condensed resin. Within the epidermis is a variable number of rows of cells of the same shape, yellow, refractive, and containing resinous juice; the medullary rays are also yellow and refractive; there are numerous large laticiferous vessels; the bark is mildly astringent and feebly aromatic, but is not bitter as stated in the Pharmacopœia of India. Rheede says that combined with ginger it is given as a sudorific. The oil of the seeds is used as an embrocation in rheumatism and as a healing application to sores. A poultice of the leaves made with milk and cocoanut oil is applied to the head in severe colds. (*Rheede.*) On the whole, the plant may be classed with the terebinthinate astringents.

Description.—The flowers are about 3 inches in diameter, sepals orbicular, thick, with membranous margins, inner pair largest; petals 4, spreading, cuneate-obovate, pure white; anthers large, oblong, golden yellow. Fruit ovoid, conical-pointed, size of a large chestnut; base surrounded by the persistent sepals, 1 to 4 seeded; seeds dark-brown, testa smooth; round the base of the young fruits a tenacious resin exudes, which in time covers them. The resin at first is soft, but hardens on exposure to the air; it is pleasantly aromatic.

Chemical composition.—The chief principle of *Mesua ferrea* appears to be an oleo-resin which abounds in all parts of the tree, and is obtained pure from the young fruits. The fresh tears sink in water, melt between 50° and 60° C., and partially dissolve in rectified spirit, amylic alcohol and ether, but wholly in benzol. Boiled with solutions of soda or ammonia the resin forms a clear mixture precipitable by acids in a white curdy condition. The solution in spirit has an acid reaction, and is dextro-rotatory when examined by polarised light; the solution gives a precipitate with alcoholic plumbic acetate, soluble when heated. From the partial solubility there are probably two resins present. Submitted to distillation 0·6 per cent. of a fragrant essential oil was obtained; this was of a pale yellow colour, and possessed in a high degree the odour of the flowers, and resembled that of the exudation of the Chio Turpentine.

The seeds yielded to ether 31·5 per cent. of fixed oil, the kernels alone gave 72·9 per cent. The oil thus obtained had a deep yellow colour, formed orange-coloured mixtures with sulphuric and nitric acid, was partially soluble in alcohol, and had a specific gravity of 0·972 at 17° C., a temperature at which it began to set, on account of the crystallization of the more solid fats. The hard pericarp contained a considerable amount of tannin.

Commerce—True Nágkesar is not an article of commerce in India. The oil of the seeds is sometimes offered for sale. Value, Rs. 4 per maund in Canara.

OCHROCARPUS LONGIFOLIUS, *Benth. and Hook.*

Fig.—*Wight. Ill. i.*, 130; *Ic. t.* 1999.

Hab.—Western Peninsula. The flower buds.

Vernacular.—Punnág; Támbra-nágkesar (*Mar.*), Ráti-nágkesar (*Guz.*).

History, Uses, &c.—The dried buds of this tree are known in commerce as red Nágkesar. The tree grows in the forests of the Western Peninsula from Canara to the Concan, and is called Suringi by the Marathas and Punnága in Sanskrit; the buds are used chiefly for dyeing silk, but have also astringent and aromatic properties, and are sometimes prescribed medicinally. The fruit is eaten by children, who call it Gori-undi, or sweet Undi. The seed, which is as large as an acorn, exudes a viscid gummy fluid when cut. The medicinal properties of this plant are very similar to those of *Mesua ferrea.*

Description.—Flowers two-thirds of an inch in diameter, white, on nodes clothed with subulate bractioles in the axils of

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fallen leaves; buds globose; pedicels 1 inch, slender; calyx bursting into 2 valves, reflexed during flowering; petals 4, thin, deciduous, white; stamens many; style subulate; stigma broad, discoid. The flowers are often hermaphrodite in cultivation. The dried buds are of a reddish brown colour and of the size of a small clove.

Commerce.—Nágkesar comes principally from Rajapur. Value, Rs. 2-12 to 3 per maund of 28 lbs.

CALOPHYLLUM INOPHYLLUM, *Linn.*

Fig.—*Wight. Ill. i.*, 128; *Ic. t.* 77. Sweet-scented Calophyllum, Alexandrian Laurel (*Eng.*), Calophylle faux Tacamahac (*Fr.*).

Hab.—W. Peninsula, Ceylon, E. Peninsula, Andamans. The oil and seeds.

Vernacular.—Sultán Champa (*Hind.*), Undi (*Mar.*), Punnaigam (*Tam.*), Punnágamu, Ponna-chettu (*Tel.*), Suragonnemara (*Can.*). The oil, Sarpan-ka-tel (*Hind.*), Undi-che-tel (*Mar.*), Punnai-tailam, Punnai-kai, Pinna-cotai (*Tam.*), Laurel nut oil (*Eng.*).

History, Uses, &c.—This tree, wild, or in a cultivated state, is widely distributed throughout India, and is considered by some to be the Punnága or Késava of Sanskrit writers, but as its flowers are not collected, and those of Ochrocarpus are, and are still known as Punnága in Marathi, it seems probable that the latter plant is the true Punnága. The natives appear to regard both trees as varieties of one species. The Alexandrian laurel abounds in Travancore and on the Western coast. A greenish-coloured oil is expressed from the seeds, which is used for burning by the poorer classes, and is valued as an application for rheumatism, either alone or mixed with an equal portion of Hydnocarpus oil; it is also used as an application to exanthematous eruptions, and the seeds pounded with cashewnut seeds, borax and sparrow's dung are applied

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as a *lep* to hasten maturation. At Pondicherry the oil has a reputation as a specific for scabies, and according to Corre and Lejanne, it has been tried unsuccessfully at the Saigon hospital as a cicatrizing agent. The Annamite name is *yao-monou*. The pounded bark is applied to swelled testicles. The tree when wounded exudes a small quantity of bright green resin, which is not collected, nor does it appear to be made use of in any way. This substance is soft and entirely soluble in rectified spirit; it has a parsley odour, and has been confounded with Tacamahaca, the exudation of *C. Calaba*, not a native of India. Rheede says that the resin is emetic and purgative; his expression is, 'the tears which distil from the tree and its fruit'; this is quite correct, as small tears of resin may often be seen adhering to the fruit.

Description.—The fruit is ovoid or round, and greenish-yellow when ripe; it varies in size; on old trees it is often as large as a bantam's egg; the pulp surrounding the nut dries up when the seed is mature, and the previously smooth skin covering it becomes brown or black and much wrinkled; the endocarp is hard, woody, and white, as thick as the shell of a filbert; within it is an inner endocarp, soft, and corky, of a red colour, thicker than the woody shell towards the apex of the fruit, but gradually becoming very thin towards the base, the inner surface of this layer is highly polished. The seed is of the same shape as the nut; it is very oily and has a rancid taste; it consists of two hemispherical cotyledons very closely united; under the microscope a stroma of small ovoid cells is seen, through which numerous large vessels loaded with green oil run in a longitudinal direction.

Chemical composition.—The resin melts easily and dissolves completely in alcohol; according to Sommer it does not yield umbelliferone by dry distillation. The oil of the almonds is greenish yellow, bitter and aromatic, sp. gr. 0·942; it solidifies at + 5°. (*Lepine.*) The fresh kernels examined by one of us gave off 30 per cent. of water in drying, and the dried kernels afforded 68 per cent. of oil. The oil was greenish-yellow, bitter,

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and fragrant; sp. gr. 0·9315 at 16° C.; it commenced to congeal at 19° and set at 16°. The saponification equivalent was 285·6. The oil yielded 90·85 per cent. of fatty acids, sp. gr. 0·9237 at 16° and 0·8688 at 90°, melting at 37°·6, and possessing a combining weight of 283. If the oil be shaken up with a diluted solution of soda, and the red alkaline liquor be precipitated with an acid and then shaken up with ether, the ethereal extract leaves on evaporation a green crystalline residue having the odour of melilot and a bitter taste. The odorous crystalline body is also removed by agitating the oil with 85 per cent. alcohol. The oil is non-drying. Exposed for one month to the air at a temperature of 14°—20°, and for eight hours in a water-oven kept at the boiling point, the oil did not increase in weight. Treated according to Reichardt's distillation process, the oil yielded only a minute trace of volatile fatty acids. Three drops of sulphuric acid added to twenty drops of oil gave a red coloration with orange streaks; after stirring an orange-brown mixture was produced. With nitric acid a chocolate brown mixture was formed. A residue soluble in boiling water was obtained which had the peculiar odour of coumarin, but it did not yield any crystals of that substance. The oil must be classed with the cotton seed group of fixed oils.

Commerce—The oil under the name of Laurel nut oil is exported from Southern India. The exports from Travancore for the past five years had the following values:—1882-83, Rs. 74,314; 1883-84, Rs. 68,767; 1884-85, Rs. 48,997; 1885-86, Rs. 78,845; 1886—87, Rs. 57,148. The tariff valuation of the oil is Rs. 8 per cwt. as against Rs. 14 per cwt. for cocoanut-oil. The export from Alleppy in 1886-87 was 63 cwts. In Bombay it is not exported, but the country-people express it for burning, and use it medicinally. In Ceylon it is known as Domba oil. It is chiefly exported to Burmah, where it fetches a comparatively high price.

Calophyllum Wightianum, *Wall.*, *Wight. Ill.* i., 128; *Ic. t.* 106. Sira Punnai (*Tam. and Mal.*). This tree is abundant in Canara, where it is called Babbe, and extends to

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Travancore. The gum occurs in large translucent irregular lumps of a yellowish colour; it is of horny texture, somewhat brittle, without odour; the taste is soapy. When placed in water it gradually softens, and finally disintegrates into a fine granular matter which floats in the form of flaky particles of a dirty white colour, and numerous oil globules which gradually collect upon the surface; the water dissolves a small portion and becomes slightly viscid.

Calophyllum tomentosum, *Wight, Beddome Fl. Syl. xxii., t.* 2; *Wight. Ic., t.* 110. Poon (*Eng.*). A tree of the Western Peninsula and Ceylon, in Marathi Punai, yields a gum which is black and opaque, and much mixed with pieces of corky bark; it has a feeble astringent taste, and is very soluble in cold water, to which it yields a yellow brown solution exhibiting a strong blue fluorescence. Alum followed by carbonate of soda throws down apparently some of the brown colouring matter without interfering with the fluorescence, as after precipitation the solution although lighter in colour is very strongly fluorescent.

A solution purified by alum in this way has its fluorescence immediately destroyed by acids and restored again by alkalies. Examining its absorption spectrum it is found that while fluorescent the solution gives a broad absorption band at the violet end of the spectrum extending to about G.; this band disappears on destroying the fluorescence by acids, but reappears on the addition of alkalies. The solution of the gum does not appear to rotate polarized light. The gum itself communicates only a very faint fluorescence to rectified spirit. (*Lyon.*)

TERNSTRŒMIACEÆ.

CAMELLIA THEIFERA, *Griff.*

Fig.—*Trans. Linn. Soc.* XXII., t. 61; *Bentl. and Trim.* 34. Tea plant (*Eng.*), Théier (*Fr.*).

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Hab.—Upper Assam, Cachar, China. Cultivated elsewhere.

Vernacular.—Cha, Chai. (*Ind.*)

History, Uses, &c.—There is reason to believe that the use of tea was unknown before the Christian era. This has been accounted for by the fact that the districts where the plant grows wild were not till then annexed to the Chinese Empire. Its origin, like that of many other useful plants, has formed the subject of an interesting myth, which attributes its discovery to the Buddhists in the latter half of the fifth century. According to a Japanese legend related by Kaempfer, the patriarch Bodhidharma, who died in China in the year 495 A.D., was so devoted an ascetic that he denied himself even natural rest. Being one day, however, overcome by sleep, he felt, on awaking, such keen remorse for yielding thus weakly to his lower nature, that he cut off both his eyelids and flung them on the ground. From these sprang the tea-plant. The holy man partook of its leaves, and found to his surprise that it endowed him with fresh vigour to renew his meditations. He communicated his discovery to his disciples, and taught them that method of using the leaves which thenceforward became generally practised. The first mention of tea in Chinese annals is in connection with a tax imposed on it in 793 A.D. The next reference to it occurs in the account of the travels of two Mahomedans in the ninth century. Europeans, however, do not appear to have acquired any knowledge of tea until the latter half of the sixteenth century, when it is noticed by Ramusio, Maffei, van Linschoten, and Botero. Later on, it was again described by the Jesuit Trigault and by Olearius. It is generally supposed that it was first brought to Europe by the Dutch East India Company during the first half of the seventeenth century. The leaf reached Paris in 1635, and the shrub was planted there in the Royal Gardens in 1658. Russia first obtained tea in 1638, through Starkow, the envoy to the Mongol Altyn Khan, who entrusted him with two hundred packets of that commodity as a tribute for the Czar. Starkow is said to have considered it as worthless, and to have taken

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charge of it very unwillingly. It found, however, great favour with the Court at Moscow, and soon became a national beverage. As regards the introduction of tea into England, the following are the most important facts to be considered. The first English vessels which ever sailed to the East and back belonged to the expedition under Lancaster, despatched by the London Company in 1601, soon after the grant of its original charter. None of these vessels returned home until after Elizabeth's death. If tea, therefore, reached England during her reign, it must have come from the East through a foreign channel. It has been supposed by some that tea was first brought over to England from Holland by Lords Arlington and Ossory in 1666. A treatise, however, by one Thomas Garrays a retailer of tea, who wrote during the Commonwealth, proves that it was already in use amongst the English some years previously. He states that "in England it hath been sold in the leaf for six pounds, and sometimes for ten pounds the pound weight; and in respect of its former scarceness and dearness, it hath been only used as a regalia in high treatments and entertainments, and presents made thereof to princes and grandees till the year 1657." Later on in 1660, an Act of Parliament was passed, imposing a duty of eight pence on every gallon of tea made for sale. In the same year, also, Waller, the courtier-poet, wrote the following lines on the occasion of the marriage of Charles II. with Catherine of Braganza:

"The best of queens and best of herbs we owe
To that bold nation who the way did show
To the far region where the sun doth rise,
Whose rich productions we so justly prize."

From these facts we may conclude that tea was first introduced into England through the Portuguese before the year 1657. It is, however, highly improbable that it was long before that date, for until then it appears only as a very scarce and expensive luxury, and is not mentioned by a single earlier English writer. (*Tyrrell Leith.*)

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There are two well-marked kinds of tea distinguished as black and green, of each of which we have several commercial varieties. Thus, of black teas, the best known sorts are Congou, Souchong, Oolong, Pekoe and Caper; and of green teas—Hyson, Hyson-skin, Young Hyson, Twankey, Imperial and Gunpowder. Many teas are scented with the flowers of the orange, rose, jasmine, sweet-scented olive, &c. The finest teas, some of which sell for as much as 50s. per lb., are consumed by the wealthier classes in China and Russia, and to a small extent in India. These teas are not manufactured in India. The various kinds of tea are all prepared from the same plant: thus, green tea consists of the leaves quickly dried after gathering, so that their colour and other characters are in a great measure preserved; and black tea consists of the leaves dried some time after being gathered, and after they have undergone a kind of fermentation, by which their original green colour is changed to black, and other important changes produced. It should be noticed, however, that much of the green tea is coloured artificially with a mixture of Prussian blue and gypsum, or indigo and gypsum, to which a little turmeric is sometimes added.

Both black and green teas are frequently adulterated with the leaves of other plants. The colour, odour and taste of both green and black teas are communicated to hot water, an infusion of the former having a more or less greenish-yellow colour, a peculiar aromatic odour, and an astringent feebly pungent and agreeably bitter taste; while an infusion of the latter has a dark brown colour, a somewhat similar but generally less agreeable odour, and an astringent, bitterish, but less pungent taste. The principal use of tea is to form an agreeable, slightly stimulating, soothing, and refreshing beverage. It was also formerly believed that tea, from the *theine* it contained, had the effect of diminishing the waste of the body, and as any substance that does this necessarily saves food, it was regarded as indirectly nutritive; but Dr Edward Smith has shown that, on the contrary, tea increases the bodily waste by acting as a respiratory excitant, and in other ways. From containing gluten, tea has also been regarded as directly nutritive, but in the ordinary mode of making tea this substance is not extracted to any amount. The action of tea is thus described by Dr. Smith :—"It increases the assimilation of food both of the flesh and heat-forming kind; and with abundance of food must promote nutrition, whilst in the absence of sufficient food it increases the waste of the body." Tea is also a powerful astringent, and should not, therefore, be taken until some time after meals, as it is likely to produce dyspepsia from the combination of its tannic acid with the gelatine of the food and the production of an insoluble tannate; for the same reason if taken in excess it is likely to cause constipation. Tea should not be taken as a beverage by those who suffer from wakefulness, or by those who are liable to hysteria, or palpitation of the heart from valvular disease. As a nervine stimulant tea may be taken with advantage for headache and neuralgia, and in other affections caused by exhaustion of the system from depression of nerve power. Its effects as a nervine stimulant are due to the *theine* contained in it. (*Bentl. and Trim.*)

Pratt's experiments with *theine* seem to show that the motor nerves are not affected by it; he surrounded one crural nerve of a frog with a paste of theine and water, and irritated the spinal cord, when both legs responded with uniform alacrity. Pratt also found that when the left sciatic nerve of a beheaded frog was surrounded by a paste of theine and water, after ten minutes, irritation of the right foot produced reflex movements, whilst irritation of the left foot failed to elicit any response. T. J. Mays (*Polyclinic. Sept.*, 1887,) has shown that in theine we possess an agent which exerts no injurious action upon the organism, even when administered in large doses. To obtain this effect of theine he found subcutaneous injection sufficient, and in local neuralgias he injected as much as 15 centigrammes with excellent results. These injections were repeated daily for 21 days in obstinate cases with the effect of entirely subduing the pain; they caused no local irritation, nor did they interfere in any way with the patient's appetite or

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prevent him sleeping. For subcutaneous injection theine should be combined with an equal portion of benzoate of sodium, which greatly increases its solubility. Pratt and others have shown that muscular fibre when brought in contact with theine, becomes strongly contracted, but it is uncertain whether this effect is produced by coagulation of the myosin or not. In muscles which had been soaked in curare until the nerves were killed the same rigidity was produced.

In comparing the physiological effects of theine and caffeine upon the excretions, it has been found by some experimenters that the former does not affect the elimination of carbonic acid, while the latter diminishes it, as well as the discharge of urea, uric acid, and water, in a larger proportion than theine. Caffeine also is said to increase the watery constituent of the urine, whilst theine diminishes it. However this may be, it is a matter of familiar observation that the effects of tea and coffee upon the system are by no means identical; for while coffee causes wakefulness as well as tea, in the former case it is rather a pleasing insomnia, not unlike that occasioned by small doses of opium, tranquil for the most part, and filled with pleasing reveries: while tea, on the other hand, induces in one who in vain endeavours to sleep after its use, a state of tension of the nervous system which is in the highest degree distressing. Upon almost every one coffee acts as a stimulant which is more or less cordial, flushing the face and rendering the pulse fuller, but such effects never follow the use of tea as direct consequences. It is seldom that a single indulgence in strong coffee induces that nervous agitation and tremulousness and impaired muscular power which are ordinary effects of strong tea; and unless we are greatly mistaken, gastralgia and other neuralgic affections are much more frequent among tea-drinkers than coffee-drinkers. It is very true that some of these apparent differences may be explained by the fact that tea is generally taken with only a small modicum of cream or milk, while coffee is as commonly used with a large proportion of one or both. Indeed, in France, where coffee is the universal breakfast drink, it is

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always mixed with a great excess of milk, and is used pure chiefly after dinner, when the presence of food in the stomach retards its absorption and modifies its action. It is however customary for those who have mental or bodily work to perform before breakfast, to take a cup of "black coffee" immediately on leaving bed.

Theine and caffeine do not fully represent the sources from which they are respectively obtained. The identity of these alkaloids in their physiological action does not imply a similar identity in tea and coffee. As little should we be entitled to infer that all alcoholic drinks produce identical effects because they all contain alcohol as their chief constituent. It is just as certain that tea and coffee differ in their action upon the human system as that Rhenish or Bordeaux wine acts very differently from whisky or brandy, although in all of these liquors the common cause of their effects is alcohol. Moreover, not only are theine and caffeine physiologically identical, but so are guaranine, cocaine, and theobromine with them and with one another; and yet the operations of guarana, coca, and theobroma are different from one another, and from those of tea and coffee, in important particulars. It is unquestionably a fact of the highest possible interest that all of these vegetable products, which are used by different and remote nations, should contain identical proximate principles; but while we thus are led to admire the universality of physiological laws, we should not lose sight of the peculiarities which distinguish these important articles of human food from one another. (*Stillé and Maisch.*)

Chemical composition.—From some experiments made by us with fresh tea leaves, which had been dried by exposure to air, and which had not been subjected to any manufacturing operations, it would appear that gallic acid exists in the fresh leaf in only minute traces; but as the leaf during manufacture of tea is exposed to a high temperature, it is possible that the gallic acid in commercial tea may be present to a larger extent. Regarding quercetin, no distinctive needle-

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shaped crystals could be obtained, though a principle similar to it is present.

In the last edition of Bloxam's Chemistry it is stated the aroma of tea does not belong to the fresh leaf, but is produced, like that of coffee, during the process of drying by heat, which develops a small quantity of a peculiar volatile oil having powerful stimulating properties. The freshly dried leaf is comparatively so rich in this oil, that it is not deemed advisable to use it until it has been kept for some time. We have found that freshly gathered leaf which has been dried simply by exposure to air possesses in a marked degree the aroma of manufactured tea. Our experiments would lead us to infer that the bouquet of tea is not solely dependent upon this volatile oil, which exists ready formed in the leaf, but is also due to the development by the action of heat, or some principle present in the leaf, of another odorous principle, and that the temperature necessary for the production of this secondary odorous principle need not exceed 100° Fahr.

Regarding the use of freshly manufactured tea, there appears to be an idea among some tea-planters that the use of the freshly manufactured article causes dysentery, but we are not in possession of the data on which the statement is founded.

A sample of tea bark contained 1·2 per cent. of theine, a much lower amount than is usually found in the leaves.

Manufactured tea contains a *volatile oil*, *gallotannic* and *gallic acids*, *quercetin*, and the so-called *boheic acid*, also the alkaloid *theine* said to be identical with caffeine obtained from coffee, and with the alkaloids of cocoa seeds, guarana, Paraguay tea, and kola nuts; more recently zanthine and another alkaloid, theophylline (dimethylzanthine) have been discovered in it. Theine and caffeine are trimethylzanthine. Zanthine is found in muscles, and along with creatine, assists muscular power; they are products of muscular waste. The occurrence of xanthine in tea was shown by Baginsoky in 1884 (*Zeits. f. Phys. Chem.* viii., 395.) and Kossel 1888 (*Ber. der. deutschen Chem. Ges.*

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No. 11, p. 2164,) described a new base which he named *theophylline*, very similar in character to theobromine. It melts at 264° C., and sublimes at a temperature above its melting point. The crystals are larger than those of theobromine, but have the same chemical composition. Theophylline forms definitely crystallizable salts with hydrochloric and nitric acids, platinum chloride and gold chloride, as well as a crystallizable sparingly soluble double salt with mercuric chloride. Its formula is $C^7 H^8 N^4 O^2$.

Battershall (*Food Adulterations*) gives the following as the results of the analysis by American chemists of samples representing 2,414 packages of Indian teas :—

	Per cent.			Average per cent.
Moisture	5·83	to	6·325	5·938
Extract	37·80	,,	40·35	38·841
Total ash	5·05	,,	6·024	5·613
Ash soluble in water	3·122	,,	4·280	3·516
Ash insoluble in water	1·89	,,	2·255	2·092
Ash insoluble in acid	·120	,,	·296	·177
Insoluble leaf	47·12	,,	55·87	51·91
Tannin	13·04	,,	18·868	15·323
Theine	1·88	,,	3·240	2·736

Dr. B. H. Paul and A. J. Cownley (*Pharm. Journ.*, *Nov. 19th*, 1887,) give the following interesting account of an inquiry undertaken for the purpose of ascertaining the circumstances that determine the differences of "strength" in tea:—

"One of the points to which we directed our attention was the extraction of the theine in such a way that precise analytical results could be obtained admitting of a comparison of different kinds of tea in regard to the percentage of theine. After several trials we found that the method we had previously adopted for coffee was capable of furnishing satisfactory results, and that with careful manipulation the amount of theine in tea could thus be determined with considerable accuracy.

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For this purpose 5 grams of powdered tea is moistened with hot water, well mixed with one gram of hydrate of lime, and the whole dried on a water bath. The dry residue is then transferred to a small percolating apparatus and extracted with strong alcohol. The clear liquor is to be evaporated to remove alcohol, and the remaining water solution, measuring about 50 c. c., mixed with a few drops of dilute sulphuric acid, which separates a trace of lime and partially decolorizes the liquid. After filtering the slightly acid solution, it is transferred to a separator and well shaken with chloroform, which gradually abstracts the theine. This part of the operation requires particular care, for though theine is freely soluble in chloroform it is necessary to shake the acidified water solution with several successive quantities of chloroform in order to remove the whole of the theine. Unless the quantity of theine is very large, about 200 c. c. of chloroform will be sufficient for 5 grams of tea, and that should be used in 5 or 6 separate portions, testing the last portions by distilling off the chloroform in a weighed flask until it is found that there is no more theine taken up. The whole of the chloroform solution is then to be placed in a stoppered separator and shaken with a very dilute solution of caustic soda. This will remove a small quantity of colouring matter and render the theine solution quite colourless, so that on distilling off the choloroform from a weighed flask the theine remains in a condition fit for weighing. When the operation is carefully carried out, the theine will be perfectly white. In this way we have been able to obtain results of great uniformity.

Our first experiments were made with Indian and Cingalese tea, the general result showing that both kinds contained a much higher percentage of theine than has hitherto been generally supposed, and that the variation in the amount of this substance was not considerable. In this respect, however, there seems to be a marked difference between tea and coffee; the amount of theine in tea is by no means a constant quantity, and, so far as the tea of India and Ceylon is concerned, it varies from 3·22 to 4·66 per cent. This is taking the tea in the ordinary air-dry condition in which it is met with in commerce. The following table gives the results of our determinations in twenty-eight samples that were selected for this purpose as representing a wide range of quality, as may be understood from the fact that the prices realised by the corresponding parcels in public sale varied from 7*d.* to 3*s.* per pound. The sample No. 10 was tea of exceptionally fine quality, that was valued at 6*s.* or 7*s.* per pound, and the sample No. 4 consisted of the hairs detached from the leaves in sifting :—

	Approximate elevation of place of growth.	Moisture per cent.	Theine per cent.	
			Original Tea.	Dry Tea.
Ceylon Tea.	Ft.			
1 Penhros	2,500	6·8	4·56	4·89
2 F. L. C.	......	6·0	4·56	4·85
3 Nahalma	300	5·6	4·54	4·80
4 Hairs from tea leaves	......	6·6	2·40	2·57
5 Hardenhuish Pekoe	3,500	3·8	4·08	4·24
6 Woodstock Pekoe Souchong	4,200	3·6	3·41	3·57
7 Radella Broken Pekoe	4,800	4·6	4·10	4·30
8 Morton Pekoe	400	4·2	3·98	4·15
9 Penhros Broken Pekoe	2,500	6·4	4·64	4·96
10 Strathellie Orange Pekoe	2,000	5·4	4·10	4·33
11 Nahalma Orange Pekoe	300	5·4	4·06	4·29
12 Venture Orange Pekoe	4,300	5·4	3·74	3·95
13 St. Leys Pekoe Dust	4,600	5·6	3·46	3·66
14 Venture Pekoe Souchong	4,300	4·8	3·40	3·57
15 Venture Broken Orange Pekoe	4,300	6·6	3·98	4·26
16 Calsay Pekoe Souchong	5,000	6·2	3·22	3·43
17 Venture Pekoe	4,300	5·6	3·48	3·68
18 St. Clair Orange Pekoe	4,200	4·6	3·90	4·09
Indian Tea.				
19 Pekoe tips, picked out	......	7·56	4·27	4·62
20 Broken Pekoe	......	7·00	4·48	4·81
21 Pekoe	......	6·40	4·16	4·44
22 Orange Pekoe	......	4·80	4·66	4·89
23 Pekoe	......	5·60	4·48	4·74
24 Broken Pekoe	......	4·80	3·76	3·95
25 Pekoe	......	5·40	3·66	3·86
26 "Weak" tea	......	6·80	4·06	4·35
27 "Strong" tea	......	5·80	4·18	4·43
28 Mixture	......	6·00	3·64	3·87

At present we have not had an opportunity of examining many samples of Chinese or Java tea that could be accepted as authentic, but so far as we have been able to judge the amount of theine is less than in the tea of India and Ceylon. But, so far as the tea of India and Ceylon is concerned, it is at least evident from the data above given, as compared with the prices mentioned, that the marketable value of tea is not to any great extent dependent on, or proportionate to, the amount of theine it may contain, however important that constituent may be in other respects. Neither can the "strength" of tea, as that term is generally understood, be taken as proportionate to the amount of theine. This is evident from the results of the analysis of the two samples, 26 and 27, which were selected by experienced judges of tea to represent extreme cases of difference as to strength. The amount of theine in 27 is greater than in 26, but to such a small extent that the difference in strength of the tea represented by those samples could not be ascribed to the theine they contain.

It appears to be much more probable that the "strength" of tea is chiefly determined by the amount or condition of the astringent constituent, the precise nature of which is at present only partially known. Moreover, when the mode of preparing tea is considered, it is also probable that this quality of "strength" may be largely influenced in degree by the manipulation of the leaves in the process of manufacture which comprises stages of fermentation and heating in the moist state in contact with atmospheric oxygen, both of which are conditions likely to induce alteration of material analogous to ordinary tannin. But before any definite opinion on this point can be offered in place of the general probability above suggested, it will be necessary to acquire a better knowledge of the chemical nature of that constituent of tea leaves which in some respects resembles ordinary tannin.

The commercial value of tea is at present estimated by a combined consideration of several factors, among which appear-

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ance counts to a considerable degree. In this respect the size of the leaves, indicating their age and likewise the presence of what is termed "tip," consisting of the unexpanded leaf buds, serve as indications by which tea is classed partly as Souchong or Pekoe and partly also as varieties of those kinds of tea. In addition there is also the process of tasting practised by tea brokers. This consists in preparing infusions of the different samples much in the same manner that tea is commonly used, and then forming a judgment as to the value of the samples according to the aroma, flavour, and other characteristics of the corresponding infusions. This is an art that is practised with a surprising degree of precision, so that the results arrived at by different operators agree in a very remarkable manner. In carrying out the broker's test, tea is infused for five minutes in boiling water in the proportion of about 43 grains to 3½ fluid ounces of water. The infusion is then poured off from the leaves into a cup, and the value of the tea estimated by its taste. In this operation the soluble constituents of the leaves are only partially extracted, and while more perfect exhaustion of the leaves will give about 35 per cent. of extract, the amount taken out in the ordinary broker's method of testing does not amount to more than 20 per cent on the average. Hence it is evident that attempts to value tea on the basis of the total amount of extract obtainable by treatment with boiling water must be entirely fallacious and useless for any practical purpose. In respect to the amounts of extract thus obtainable from tea of different qualities, there is not in reality any such difference as would afford indications of the actual differences in value. Peligot and others have made determinations of this kind, showing that different kinds of black tea yield from 24 to 47 per cent. of extract, or on the average, 34 to 40 per cent., but these data have little practical value. It is indeed not by the perfect extraction of tea that its value can be estimated. This must be sought for within the limits of extraction which obtain in the ordinary methods of using tea, as is the case in the broker's method of testing, which fairly represents ordinary

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practice in the use of tea, though the infusion is then made stronger than it is generally drunk.

To obtain some idea of the extent to which the constituents of tea are extracted under these ordinary conditions we have made analyses of the infusion thus prepared, and have ascertained as a general result that the 20 per cent. of extract taken out by the infusion will contain about one-half of the theine present in the tea used. An ordinary breakfast cup of equally-strong tea infusion measuring about eight ounces would therefore contain two grains of theine or thereabouts. The rest of the theine is left in the spent leaves, and it requires repeated treatment with boiling water to extract the whole quantity. This is no doubt one of the reasons why the amount of theine in tea has been under-estimated in so many instances, since experimenters have operated upon a water extract for its determination. In one instance we found that the residual leaves of tea which had been used in the customary manner contained as much as 1·7 per cent. of theine, and in another case leaves exhausted as far as practicable by percolating with boiling water still contained as much as 0·13 per cent. calculated on the original tea."

Commerce.—The great tea-producing country is China, where it is said four millions of acres of ground are devoted to its cultivation, and the produce annually is estimated at nearly three thousand millions of pounds. Tea is also largely produced in Japan, Java, Assam and Ceylon. (*Bentl. and Trim.*) Indian tea, which includes that of Assam, has now become an important article of commerce, but is objected to by many of the natives of India on account of its being more astrigent than China tea; it is chiefly exported to Europe through Calcutta. The exports during the last three years have been:—In 1885-6, 68·8 millions of pounds; in 1886-7, 78·7 millions; in 1887-8, 87·5 millions, valued at 517 lakhs of rupees.

The following figures show the percentage proportion of tea imported into Great Britain in 1886 and in 1887 from different

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countries, and bear witness to the increasing favour with which Indian tea is regarded in England:—

	China.	British India.	Ceylon.	Java.	Other Countries.
1876, per cent. ...	84·03	14·99	0·05	0·78	0·15
1877, „ „ ...	53·17	31·15	5·89	0·32	2·47

—*Chemist and Druggist, April* 1889.

Gordonia obtusa, *Wall., Wight Ill. i.* 99, is a tall tree of the Western Peninsula from the Concan to Pulney hills, and is called Nagetta by the hill people. The leaves have been used in the Nilgiris as a substitute for tea; they resemble the tea leaf in size and shape, but may be distinguished by their obtuse points. The leaves contain a crystallizable and sublimable alkaloid like caffeine to the extent of 0·04 per cent., also tannic acid, and an odorous body very much like that contained in ordinary tea. The ash is lower: 3·96 to 3·67 per cent.

SCHIMA WALLICHII, *Chois.*

Fig.—*Griff. Notul.* iv., 562, t. 600.

Hab.—Eastern Himalaya, Nipal to Bhotan, Assam, Burma.

Vernacular—Chilauni, Makriya-chilauni (*Hind.*). The Hindi names for this tree signify "that which causes itch," "that which causes monkey's itch." The part of the tree which has this effect is the bark, in which the liber-cells appear like glistening white needles which irritate the skin like cowhage, which drug it resembles in being a mechanical irritant. The bark is thick, externally smooth, of a greyish-brown colour and very irregular surface, caused by deep fissures and exfoliation of portions of the suber; internally it is of a reddish-brown colour and short fracture, and is remarkable for a number of white glistening liber-cells about $\frac{1}{12}$ of an inch long, which when magnified are seen to be translucent and sharp-pointed at both ends. The bulk of the parenchyma consists of cells containing much starch and a red colouring matter.

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DIPTEROCARPEÆ.

DIPTEROCARPUS TURBINATUS, *Gärtn.f.*

Fig.—*Roxb. Cor. Pl.* iii., 10, *t.* 213.

Hab.—Eastern Bengal, Eastern Peninsula.

DIPTEROCARPUS INCANUS, *Roxb.*

Hab.—Chittagong, Pegu.

DIPTEROCARPUS ALATUS, *Roxb.*

Fig.—*Gärtn. f. Fruct.*, iii. 50, *t.* 187.

Hab.—Chittagong, Burma, Tenasserim, Andamans. Oil Tree. The oleo-resin, Garjan Balsam, Wood oil (*Eng.*).

Vernacular.—Garjan-ka-tel (*Hind., Bomb., &c.*), Yennai (*Tam.*).

History, Uses, &c.—Seventeen species of Dipterocarpus are noticed in Hooker's *Flora of British India* as growing in India and the Eastern Islands, but the three placed at the head of this article produce most of the Garjan Balsam of commerce. The Balsam does not appear to have been made much use of as a medicine by Hindus or Mahometans, for we have not found it noticed at any length in their standard works on Materia Medica. Under the name of Duhn-el-Garjan, a short notice of it will be found in the Makhzan. Ainslie mentions its use by the natives of Southern India in gonorrhœa. It was first brought prominently to the notice of Europeans by O'Shaughnessy in the Bengal Dispensatory as a substitute for Copaiba, but has never displaced that drug even in India, although favourable reports of its properties have from time to time appeared in the Medical journals. The natives of the East use it largely as a varnish, and for paying the seams of boats, as it is thought to preserve timber from the ravages of insects. Quite recently it has been brought prominently to

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notice by Dr. Dougall, of the Andamans, as a remedy for leprosy. According to that gentleman, Garjan Balsam when administered internally and at the same time applied to the skin arrests the disease and promotes cicatrization of the ulcerating surfaces. In order to test the correctness of this statement, large quantities of the Balsam have been distributed by the Indian Government, but as far as we have heard the new treatment has not been a success. Dr. Dougall's directions for carrying out the treatment of leprosy by Garjan Balsam include frequent ablutions with dry earth and water, and strict attention to the hygienic condition of the patient; it seems probable that he has attributed effects to the Balsam which are in reality due to cleanliness and an improved hygienic condition. The method of extracting the Dipterocarpus Balsam was first described by Roxburgh; more recent accounts have been published, but they do not differ in any points of importance from his; shortly, one or more good-sized cavities are cut with an axe in the trunk of the tree about the end of the dry season, a fire is then lighted in them until the wood is scorched; arrangements are next made to catch the Balsam, which exudes very freely. The oil is extracted yearly from the same trees, and according to Roxburgh, a good tree will produce 30 to 40 gallons during the season; the surface of the cavity has to be occasionally cut away and re-burnt. Garjan Balsam has a stimulant action upon mucous membranes, especially that of the urinary tract, during its excretion by the kidneys. Like copaiba it forms a conjugate glycuronic acid in the system which appears in the urine, and with nitric acid gives a precipitate of gurjanic acid easily mistaken for albumen, but distinguished by its disappearing on the application of heat. The conjugate acid renders the urine antiseptic and prevents the development of bacteria.

Description.—The freshly-drawn Balsam is an opaque, grey fluid, which when placed in the sun gradually separates into two portions, the upper of which is a thick, viscid fluid of a dark reddish brown colour, and transparent when placed between the eye of the observer and the light, but when viewed by reflected light it is opaque, greenish, and fluorescent. The lower stratum consists of a thick, dirty white magma, and is generally rejected, although it is said to have the same medicinal properties as the clear Balsam. The latter has a feeble copaiba odour, and a bitter aromatic taste; its specific gravity at 16·9° C. is ·964; it is soluble in pure benzol, cumol, chloroform, bisulphide of carbon, and essential oils, and partially so in methylic, ethylic, or amylic alcohol, in ether, acetic ether, glacial acetic acid, carbolic acid, or caustic potash dissolved in absolute alcohol; at about 130° C., it becomes gelatinous, and on cooling does not recover its fluidity.

Chemical composition.—The following account by Flückiger and Hanbury is taken from the *Pharmacographia* :—"Of the Balsam 6·99 grammes dissolved in benzol and kept in a water bath until the residue ceased to lose weight, yielded 3·80 grammes of a dry, transparent, semi-fluid resin, corresponding to 54·44 per cent., and 45·56 of volatile matters expelled by evaporation.

"By submitting larger quantities of the Balsam to the usual process of distillation with water in a large copper still, 37 per cent. of volatile oil were easily obtained. The water passing over at the same time did not redden litmus paper; a dark viscid, liquid resin remained in the still.

"The essential oil is of a pale straw colour, and less odorous than most other volatile oils; treated with chloride of calcium and again distilled it begins to boil at 210° C., and passes over at 260° C., acquiring a somewhat empyreumatic smell and light yellowish tint. The purified oil has a sp. gr. of 0·915 to 0·914, it is but sparingly soluble in absolute alcohol or glacial acetic acid, but mixes readily with amylic alcohol. According to Werner, this oil has the composition $C^{40} H^{32}$, like that of copaiba. He says it deviates the ray of polarised light to the left, but that prepared by one of us deviated strongly to the right, the residual resin dissolved in benzol being wholly inactive. The oil does not form a crystalline compound with dry hydrochloric

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acid which colours it of a beautiful blue. DeVrij states that the essential oil after this treatment deviates the ray to the right.

"The resin contains, like that of copaiba, a small proportion of a crystallizable acid, which may be removed by warming it with ammonia in weak alcohol. That part of the resin which is insoluble even in absolute alcohol, we found to be uncrystallizable. The gurjunic acid may consequently be prepared by extracting the resin with alcohol (·838) and mixing the solution with ammonia. From the ammoniacal solution gurjunic acid is precipitated on addition of a mineral acid, and if it is again dissolved in ether and alcohol it may be procured in the form of small crystalline crusts. Gurjunic acid, $C^{44} H^{68} O^{8}$, according to Werner, melts at 220° C, and concretes again at 180° C.; it begins to boil at 260° C., yet at the same time decomposition takes place. By assigning to this acid the formula $C^{44} H^{64} O^{5} + 3 H^{2}O$, which agrees well with Werner's analytical results, we may regard it as a hydrate of abietinic acid, the chemical behaviour of which is perfectly analogous. Gurjunic acid is soluble in alcohol 0·838, but not in weak alcohol; it is dissolved also by ether, benzol, or bisulphide of carbon.

"In copaiba from Maracaibo, Strauss discovered metacopaivic acid, which is probably identical with gurjunic; the former however fuses at 206° C. The amorphous resin forming the chief bulk of the residue of distillation of the balsam has not yet been submitted to exact analysis. We find that after complete dessication it is not soluble in absolute alcohol." Flückiger has since discovered (1878) in Garjan Balsam a crystallizable indifferent resin, formula $C^{28} H^{46} O^{2}$; it melts at 258·8° F. and dissolves in sulphuric acid with an orange colour.

Commerce.—Garjan Balsam is not an article of commerce in most parts of India, but small quantities may be sometimes obtained in the native drug shops. In Calcutta its price is from 3 to 5 rupees per maund of 80 lbs. Large quantities are exported from Moulmein to Europe. The Government supplies have been obtained from the Andaman Islands.

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SHOREA ROBUSTA, *Gärtn. f.*

Fig.—*Beddome Fl. Sylv.*, *t.* 40. The Saul tree (*Eng.*).

Hab.—Tropical Himalaya, Central India, Western Bengal. The resin.

Vernacular.—The resin, Rál, Dhuna (*Hind.*, *Beng.*, *Mar.*), Kungiliyam (*Tam.*), Guggilamu (*Tel.*), Guggala (*Can.*).

History, Uses, &c.—The Sál tree, called in Sanskrit Sála and Asvakarna, is of interest from a mythological point of view, as the mother of Buddha is represented as holding a branch of the tree in her hand when Buddha was born, and it was under the shade of a Sála tree that Buddha passed the last night of his life on earth. The small branches of the Sála are used by Indian villagers to detect witches; they write the name of every woman over 12 years of age in the village upon a branch; the branches are then placed in water and left for 4½ hours; if any woman's branch withers, she is the witch.

This tree is very widely distributed throughout India, and is undoubtedly the source of the Rosin or Rál of Hindu and Mahometan writers on Materia Medica. Rál, in Sanskrit Rála and Sála-veshta, is regarded by the Hindus as attenuant, detergent, and astringent, and is sometimes prescribed internally mixed with sugar, honey or treacle; as resin does with us, it enters into the composition of stimulating plasters and ointments; it is also used for fumigating rooms occupied by the sick. The seeds of the Saul tree are eaten in times of scarcity with Mahwa flowers by the wild tribes of India. Mahometan writers give a similar account of its properties and uses. The author of the Makhzan-el-Adwiya (*vide* article Kaikahr) notices the fact that more than one kind of Rál is met with, but names the Sakoh or Sál as the source from which the genuine article is obtained. In another part of his work (*vide* article Sakoh) he describes the tree, and says that when old the bark becomes separated from the trunk by the deposit of Rál beneath it. Ainslie mentions three kinds of resin or dammar as common in the bazars of Southern India, but is in doubt as to the sources from

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whence the different kinds are obtained. He observes that a great portion of the dammar used in India is imported from Java, Borneo, Joanna, and several of the Soloo Islands. The author of the Bengal Dispensatory, after conducting a series of experiments with genuine Sál resin, pronounced it to be an efficient substitute for pine resin. In Bombay, at the present time, American rosin is to a great extent displacing Indian Râl. Dr. Sakharam Arjun states (*Bomb. Drugs*) that he has seen Shorea resin mixed with sugar, given with good effect in dysentery. The oil of the seeds is extracted in Malabar. In the Wynaad *Shorea Talura, Roxb.* (*S. laccifera, Heyne,*) yields a fragrant resin, known as *Sambrani,* which is burnt as an incense.

Description.—Rál varies in colour from dark brown to pale amber; it is devoid of taste and smell; sp. gr. 1·097 to 1·123, easily fusible, partially soluble in alcohol (83·1 per 1000), almost entirely in ether, perfectly in oil of turpentine and the fixed oils; sulphuric acid dissolves and gives it a red colour. By dissolving the resin in oil of turpentine and boiling it with a solution of potash until all the turpentine was expelled, O'Shaughnessy obtained a compound of resin and potash entirely soluble in water. The seeds have been examined by Church with the following result:—Water 10·8, albumenoids 8·0, starch 62·7, oil 14·8, fibre 1·4, ash 2·3 in 100 parts.

Commerce.—Rál is imported into India from Singapore in casks and bales. Value, Rs. 6 per cwt.

VATERIA INDICA, *Linn.*

Fig.—*Beddome Fl. Sylv., t.* 84; *Wight Ill. i.* 88, *t.* 36. Piney tallow tree (*Eng.*).

Hab.—Western Peninsula. The resin and fat.

Vernacular.—The tree, Dupada; the resin, Vellai-kungiliyam (*Tam.*)

History, Uses, &c.—The resin known as Vellai-kungiliyam has long been used by the natives of Southern India

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as an incense; and for making varnishes. It is obtained by cutting notches in the tree, when it exudes and gradually hardens. Specimens differ much in colour, fragrance and density; some being of a light greenish colour, dense, homogeneous and vitreous on fracture, whilst others are amber-coloured, and vesicular. These differences apparently arise from the mode of collection; and the age of the trees producing them. It burns with a clear, steady light, giving off a pleasant smell, but very little smoke. With the aid of heat, and the addition of a small portion of camphor, it is soluble in spirit. Under the influence of gentle heat it combines with wax and oil, and forms an excellent resinous ointment. (*Dr. G. Bidie in Pharmacopœia of India.*) Vateria seeds yield a vegetable butter, known as the *Piney tallow* of Canara, or Malabar; this fat has a considerable reputation as a local application in chronic rheumatism, and might be used as a basis for ointments where increased consistency is required. It closely resembles the solid fats of *Garcinia* and *Bassia*, and like them consists chiefly of solid fatty acids. It would, no doubt, be valuable in the preparation of nitrate of mercury ointment. (*See article on Garcinia indica.*)

Chemical composition.—The seeds have been examined by M. M. Höhnel and Wolfbauer, who found that when air dried they afforded 49·2 per cent. of a greenish-yellow solid fat, which bleaches rapidly on exposure to light and has a peculiar agreeable balsamic odour. This fat rapidly saponifies, and consists of a mixture of fatty acids melting at 56°·6 and solidifying at 54°·8 C. The mixture contains oleic acid, and 60 per cent. of a solid fatty acid melting at 63°·8. (*Chem. Centr.*; *Journ. de Pharm. et de Chim.*; *Journ. Chem. Soc.*, 1886.)

DRYOBALANOPS AROMATICA, *Gärtn.*

Fig.—*Hook. Journ. Bot.*, 1852, *t.* 7; *Hayne xii.*, *t.* 17. Borneo Camphor (*Eng.*).

Hab.—Sumatra, Borneo.

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Vernacular.—Bhimséni Kápúr or Káfúr (*Hind.*, *Bomb.*).

History, Uses, &c.—Sanskrit writers mention two kinds of camphor, *Pakva* und *Apakva* (cooked and uncooked); it is generally considered that Borneo camphor is meant by the latter term. In the Rájanirghantu oil of camphor is mentioned; this may refer to the Borneo camphor oil, or to some preparation made by dissolving camphor in oil. Mahometan writers describe the Borneo camphor as the best kind, and notice the way in which it is obtained by splitting the trunk of the tree. The author of the Makhzan-el-Adwiya gives a full account of it, and mentions the fact of several pieces of the timber having been brought to the Hughli, which when cut up into planks yielded a quantity of camphor. He also describes the way in which the oil is obtained by incising the tree. Borneo camphor is supposed by native physicians to have the properties of camphor in a much higher degree than ordinary camphor; on this account it fetches an extraordinarily high price. From the researches of Flückiger and Hanbury it appears that this camphor was the only kind known in Europe in the Middle Ages and was the καφουρά of the later Greek writers, who obtained their knowledge of it from the Arabians. Camphor is considered by the Hindus to be hot and dry, and by the Mahometans to be cold and dry, and to stimulate the brain and heart; it is prescribed in a great variety of disorders. The Hindus consider Borneo camphor to be aphrodisiacal, but the Mahometans hold a contrary opinion; both regard it as a valuable cooling application to the eyelids in inflammatory conditions of the eye. Ainslie mentions the Dryobalanops camphor as having been recently described by Mr. H. T. Colebroke, who was the first to determine its Botanical source, but wrongly supposes it to be the chief source of the camphor used in India. Mr. John Macdonald (1793) described the collection of the camphor in Sumatra in the following terms:—"The Sumatrians previous to their setting out in search of camphor discharge a variety of religious duties and ceremonies. They select old trees and pierce them, if they yield oil plentifully it

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is presumed they contain concreted camphor, which is found in small whitish flakes, situated perpendicularly in irregular veins, in and near the centres of the trees. The tree is cut down, divided into junks and carefully divested of its camphor. The camphor is repeatedly washed and soaked in soapy water to clean it. When clean it will sink in water, and have a white glossy smooth appearance, tending to transparency After washing it is passed through three sieves of different mesh, so as to be divided into head, belly, and foot camphor: certain proportions of each compose the chests made up for the China market, where they are sold for £350 sterling nearly. An inferior kind is made by boiling down the liquid oil. Sumatra affords annually from 15 to 20 piculs of 133¼ lbs. each, and more oil than there is at present a demand for." (*As. Researches, iv.*, 19.) Flückiger and Hanbury in the *Pharmacographia* say:—"The produce of a single tree does not, it is supposed, often exceed 11 lbs. A good proportion of the small quantity produced is consumed in the funeral rites of the Batta princes. The camphor which is exported is eagerly bought for the China market, but some is also sent to Japan, Laos, Cochin China, Cambodia and Siam." In India it is chiefly used by the Jains to prepare an *Abir* or sacrificial powder called *Vasakshepa*; this powder consists of sandalwood, saffron, Borneo camphor and musk

Dr. Stockman has proved that Borneo camphor has exactly the same physiological action as laurel camphor. He points out that laurel camphor, borneol and menthol form a group of substances very closely allied to each other in physiological action, borneol resembling very nearly monobromide of camphor in this respect. All are closely related to the alcohol group in their physiological effects, menthol approaching the latter most nearly; but as the number of hydrogen atoms diminishes there is an increased tendency to convulsions of cerebral origin. Borneol and menthol however differ from pure ethylic alcohol in powerfully dilating the peripheral vessels. Borneol is also a less irritating substance locally than laurel camphor, and can be given in much larger doses than the latter without causing untoward cerebral symptoms.

Description and chemical composition.—Borneo camphor, also termed by chemists Borneol or Camphyl alcohol, is somewhat harder than common camphor, also a little heavier, so that it sinks in water. It is less volatile, and does not crystallize on the interior of the bottle in which it is kept; and it requires for fusion a higher temperature (198° C.). It has a somewhat different odour, resembling that of common camphor, with the addition of patchouli or ambergris. The composition of Borneol is represented by the formula $C^{10} H^{18} O$. It may be converted by the action of nitric acid into common camphor, conversely, as Berthelot has shown, Borneol may be prepared from common camphor by heating the latter with alcoholic potash. The artificial Borneol has the same composition as the natural article, but differs in optical power, and has therefore been termed Camphol. (*Pharmacographia.*) An alcoholic solution of Borneol examined by Dr. Lyon of Bombay proved to be 12½° dextrogyre. Besides camphor, the Dryobalanops furnish a liquid termed camphor oil, which must not be confounded with the camphor oil that drains out of crude laurel camphor. This Bornean or Sumatran Camphor oil is called Borneene, and is isomeric with oil of turpentine, $C^{10} H^{16}$, yet in the crude state, holding in solution Borneol and resin. By fractional distillation it may be separated into two portions, the one more volatile than the other, but not differing in composition. (*Pharmacographia.*)

According to Dr. Beckman laurel camphor may be converted into Borneo camphor in the following manner:—The camphor is dissolved in ether or some other solvent indifferent to the action of sodium, and repeatedly treated with sodium and then with water. The reaction is shown by the equation—

$$2\, C^{10} H^{16} O + Na = C^{10} H^{15} Na O + C^{10} H^{17} Na O.$$

These sodium compounds are decomposed by water with the formation of molecular quantities of camphor and borneol:

$C^{10} H^{15} Na O + C^{10} H^{17} Na O + 2 H^{2} O = C^{10} H^{16} O + C^{10} H^{18} O + 2 Na O H.$

The solution of camphor and borneol so obtained is treated afresh with sodium and water until all the camphor is converted into borneol.

Commerce.—The quantity annually shipped from Borneo was reckoned by Motley in 1851 to be about 933 lbs., the export from Sumatra was estimated by De Vriese at 10—15 quintals per annum. The quantity imported into Canton in 1872 was returned as 3,159 lbs., value 42,326 taels, equivalent to about 80*s.* per lb. In the Annual Statement of the Trade of Bombay for the year 1872-73, 2 cw[illegible] of Malayan camphor is stated to have been imported; it was valued at Rs. 9,141. The price in Borneo in 1851 of camphor of fine quality was 30 dollars per catty, or about 95*s.* per lb. (*Pharmacographia.*) At the present time, good Borneo camphor is worth in India Rs. 100 per lb.; an inferior quality is sold at from Rs. 70—80 per lb. An alcoholic solution of the latter examined by Dr. Lyon was about 2½° lævogyre; on this account he thinks it must be a mixture of Borneo and Ngai camphor, the product of *Blumea balsamifera* (For a description of which, see *Pharmacographia.*)

MALVACEÆ.

ALTHÆA OFFICINALIS, *Linn.*

Fig.—*Bentl. and Trim., t.* 35. Marsh Mallow (*Eng.*), Guimauve (*Fr.*).

Hab.—Temperate climates. The flowers, carpels, leaves and root.

Vernacular.—The flowers, Gul Khairu (*Pers.*, *Ind.*); the carpels, Tukm-i-Khitmi (*Pers.*, *Ind.*); the root, Rishah-i-Khitmi (*Pers.*, *Ind.*).

History, Uses, &c.—A plant called Althæa is mentioned by Dioscorides,* and was held in great esteem by the Greeks and Latins † on account of its healing properties. Theophrastus says of Althæa, καί ἣν οἱ μεν ἀλθαίαν, ’εκεῖνοι δε μαλάχην ἀγρίαν καλουσι. Some consider the althæa of Theophrastus to have been *Lavatera arborea* (the tree mallow), but as it is described as having yellow flowers (*ix.*, 19,) this cannot be correct. Perhaps *Abutilon Avicennæ, Gärtn.*, was the plant. The Mahometans describe *Khairu* as a suppurative and emollient; they use the leaves as a poultice and for fomentations; mixed with oil the leaves and flowers are applied to burns and parts bitten by venomous reptiles. The root boiled with sugar is prescribed in coughs and irritable conditions of the intestines and bladder. The decoction is also used as an emollient enema, and in making ointments; in short, with the Mahometans it is as important an article of the Materia Medica as with the French and other Continental nations in Europe. Althæa is demulcent and emollient; its action is mechanical, inasmuch as it forms a soft smooth covering to the inflamed or irritated parts with which it comes in contact and thus protects them from friction, and allows the process of repair to go on undisturbed.

Description.—The different parts of the plant used in India are imported from Persia. The flowers have by some been attributed to *A. rosea*, but the carpels which may be found mixed with them, have not the membranaceous margin of that plant, and the exterior calyx has from 8 to 9 divisions instead of 6. The calyx is thick, and covered with simple hairs, very closely set, and arranged in star-like tufts; the flower has five petals, which in the dry article are bluish green at the base, the blades being purple; both calyx and flowers are mucilaginous. The root appears to be the same as the European article, but it is not decorticated, nor is it so plump and free from fibre. The carpels are large and pubescent, and are known as Tukm-i-khitmí.

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* Dios. iii., 154.

† Pliny 20, 84.

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Microscopic structure.—The cortex of the root is chiefly liber; the parenchyme consists partly of starch and partly of mucilage cells; stellate raphides may be seen. The central portion is composed of wood cells, scalariform and pitted vessels, and parenchymatous tissue.

Chemical composition.—According to Flückiger and Hanbury, the mucilage in the dry root amounts to about 25 per cent. and the starch to as much more. The former appears to agree with the formula $C^{12} H^{20} O^{10}$, thus differing from the mucilage of Gum Arabic by one molecule less of water. It likewise differs in being precipitable by neutral acetate of lead; at the same time it does not show the behaviour of cellulose, as it does not turn blue by iodine when moistened with sulphuric acid, and it is not soluble in ammoniacal solution of oxide of copper. The root also contains pectin and sugar, and a trace of fatty oil. Tannin is found in very small quantity in the outer bark alone. Marshmallow root contains from 0·8 to 2·0 per cent. of asparagin, which is a widely diffused constituent of plants; it crystallizes in large prisms or octohedra of the rhombic system, and is tasteless and apparently destitute of physiological action. The peeled root dried at 100° C. and incinerated affords 4·88 of ash, rich in phosphates. (*Pharmacographia.*)

Commerce.—The flowers, carpels and root are imported from Persia. Value, flowers, 2 annas per lb.; seeds, 4 annas; root, 4 annas.

In connection with this drug may be mentioned the Althéa of the Portuguese at Goa, a substitute for Althæa; it is the root of *Grewia scabrophylla, Roxb.* The drug consists of the young roots, the largest being about as thick as the little finger. They are straight, unbranched, and have a thin brown cortex covering a thick white parenchyma, in which are seen well marked yellowish medullary rays, spreading from a tough, woody, central column, the diameter of which is less than the semi-diameter of the white portion; examined under the microscope most of the cells of the parenchyme are seen to be

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filled with starch granules; but some large ones contain mucilage only. The central woody column abounds in large pitted vessels. Soaked in water the root gives out abundance of mucilage having a faintly bitter taste. When properly scraped and dried it is very white and apparently an efficient substitute for the imported article.

The roots of *Hibiscus Rosa sinensis*, Shoe-flower (*Eng.*), Ketmie de Cochin-Chine (*Fr.*), the Jásund or Jásus of Bombay, the Java of Hindustan, Shappathupu of Madras, Foulsapattes of the French Creoles, and Java or Japa of Sanskrit writers, are also dried and sold in the shops as a substitute for Althæa. In the Concan the fresh root-juice of the white flowered variety is given in doses of two tolás with milk, sugar and cummin for gonorrhœa, and the root powdered is given with an equal quantity of Lotus-root and the bark of *Eriodendron anfractuosum* in the same manner for menorrhagia, the dose of the three being 6 massas. This shrub is the Flos festalis of Rumphius (vi., II.), who relates the confession of a native of Banda in 1655 that he had caused the abortion of his concubine by giving her the flowers rubbed down with Papaya seeds. He says they are popularly considered to be emmenagogue in Amboyna. In India the Papaya is considered an abortifacient, but not the flowers of *H. Rosa sinensis*; the notion is evidently a fanciful one, and connected with their red colour.

MALVA SYLVESTRIS, *Linn.*

Fig.—*Eng. Bot.* 671. Common Mallow (*Eng.*), Mauve sauvage (*Fr.*).

Hab.—Temperate climates. The fruit.

Vernacular.—Khubázi (*Arab.*, *Ind.*).

History, Uses, &c.—This plant, or *M. rotundifolia*, is generally supposed to have been the μαλαχη of Dioscorides,[*]

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[*] Dios., ii., 109, who says that Zoroaster called it Diadesma and the Egyptians Khokorteen. Prosper Alpinus describes and figures *Corchorus olitorius* as Melochia. Theophrastus, H. P. I., 4, describes Malache as a shrub; his plant may have been *Lavatera arborea*.

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which was used by both Greeks and Romans as a medicine on account of its mucilaginous and cooling properties. It is the Nán-i-kulagh, "crow's-bread," and Khitmi-i-kuchak, "small Khitmi" of the Persians. Mauláná Nafis describes three kinds of malokhia, *viz.*:—

1*st*, A cultivated kind called Malokhia.
2*nd*, A large wild kind called Khitmi.
3*rd*, A small wild kind called Khubázi.

The author of the Makhzan-el-Adwiya pronounces the last mentioned to be the article known as Khubázi, and describes it thus:—"Leaves roundish, tasteless, a little hairy on the under surface; flower small, reddish purple; fruit round and flat, depressed in the centre, colour white or brown. The plant is much smaller than Khitmi." All parts of this plant are commended in Mahometan works on account of their mucilaginous and cooling properties, but the fruit is considered to be most efficient. Pliny, quoting Xenocrates, says that the seeds are aphrodisiacal, and such would appear to be the opinion of the Mahometans of India. In modern medicine the common mallow is considered to have properties similar to Althæa.

Description.—The fruit consists of from 10—12 glabrous wrinkled carpels, each containing one reniform seed; some of it is mature, but at least half is in various stages of immaturity, a portion of the thin papery calyx is attached to the fruit, and in a good fresh sample a few deep blue flowers may be found as well as the peduncles and portions of the leaf. Some seed planted in Bombay in June grew freely, and produced strong flowering plants in the rainy season.

Chemical composition.—Water dissolves the mucilage and a little bitter extractive.

Commerce.—The fruit is imported from Persia under the name of Khubázi. It is worth Re. ¼ per lb.

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SIDA CARPINIFOLIA, *Linn.*

Fig.—*Wight Ic., t.* 95; *Hort. Mal. x.,* 53.

SIDA RHOMBIFOLIA, *Linn.*

Fig.—*Cav. Diss. I., t.* 3, *f.* 12.

SIDA CORDIFOLIA, *Linn.*

Fig.—*Dil. El.* 171, *f.* 209.

SIDA SPINOSA, *Linn.*

Fig.—*Cav. Diss. I., t.* 1, *f.* 9.

Hab.—The tropics generally. The roots.

Vernacular.—*S. carpinifolia, rhombifolia* and *cordifolia,* Bariára (*Hind.*), Bala, Janglí-methí (*Guz.*), Tupkaria, Tukati, Chikana, Páta (*Mar.*), Malai-tangí, Mayir-manikham (*Tam.*), Chitimuttí, Mayir-manikkam (*Tel.*), Svet-berela, Koreta, Bon-methi (*Beng.*) *S. spinosa,* Gulsakari (*Hind.*).

History, Uses, &c.—The plants belonging to this genus are known in Sanskrit by the general name Bala. Five kinds of Bala are mentioned by Sanskrit medical writers under the name of *Pancha-bala,* viz., Bala, Nágabala, Mahabala, Atibala and Rajabala. The Hindus regard the roots of the different species of Sida as cooling, astringent and tonic; they prescribe them in nervous and urinary diseases, and in fever. The root bark is beaten up with milk and sugar, and aromatics and stimulants are sometimes added. (*For original prescriptions, see Dutt's "Hindu Materia Medica,"* p. 121.) In the Concan the leaves of *S. cordifolia* (Chikana) with other cooling leaves are applied in ophthalmia; the root-juice is used to promote the healing of wounds, and the juice of the whole plant pounded with a little water is given in ¼ seer doses for gonorrhœa. The root of *S. carpinifolia* (Tupkaria) is applied with sparrow's dung to burst boils. The Mahometans consider Bala to be aphrodisiac. Ainslie notices several species of Sida,

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and the uses to which they are applied by the Hindus. The author of the Bengal Dispensatory, after a trial of the roots of *Sida carpinifolia,* was unable to satisfy himself as to its febrifuge action, but it was found to promote perspiration, to increase the appetite, and to act as a useful bitter tonic. In Goa the Portuguese value it as a diuretic, especially in rheumatic affections; they also use it as a demulcent in gonorrhœa. In Pudukota the plant of *S. humilis, Willd.*, is ground with onions and administered for gonorrhœa. Its Tamil name is Pelambaci. *S. rhombifolia* is called in Australia "Queensland Hemp," and in N.-S. Wales "Lucerne," as cows are very fond of it. It is also called "Jelly-leaf" on account of its mucilaginous nature. In the various species of Sida we have demulcent and emollient properties combined with bitterness.

Description.—The roots of the different species of Sida are about ¼ of an inch in diameter at the stock, woody, and fibrous. The bark is of a light yellowish brown colour; unless the leaves are attached they cannot be distinguished with any certainty. In Western India, *S. carpinifolia* and *S. cordifolia* are most used. The first has smooth lanceolate, serrated leaves; the second cordate, tomentose leaves.

Chemical composition.—The root of *S. carpinifolia* strikes a blue colour with salts of iron, does not precipitate gelatine, yields to boiling water 23 and to alcohol 19 per cent.; it contains asparagin.

Commerce.—None of the roots are articles of commerce.

ABUTILON INDICUM, *G. Don.*

Fig.—*Wight Ic.*, *t.* 12. Country Mallow (*Eng.*).

Hab.—Tropical India, Ceylon. The bark, leaves, and seeds.

Vernacular.—Kanghí (*Hind.*), Potári, Madmi, var *tomentosum*, Chakra-bhenda (*Mar.*), Tubocuty (*Goa.*), Tutti (*Tam.*) Kapáta, Dábali (*Guz.*). The seeds, Balbij (*Hind.*, *Bomb.*)

History, Uses, &c.—There are several varieties of this plant, the most remarkable being a tomentose, hoary variety, which produces the Balbij of the shops, and another with purple stems called Kali kanghi in Hindustani and Koran-tutti in Tamil. The leaves, bark and seeds would seem to have been long in use among the Hindus on account of their mucilaginous and diuretic properties. Under the names of Masht-el-ghoul and Deishár, short notices of the plant may be found in Arabic and Persian books. Ainslie's *Sida Mauritiana* is evidently identical with it. The bark is valued as a diuretic, and the seeds on account of their demulcent and mucilaginous properties. *A. indicum* is very common on waste ground, and appears to flourish in poor soil, and requires but little water. Ibn Sína mentions a drug called Abútilún ابوطيلون which was applied to wounds, but as he likens it to a Pumpkin it must have been quite different from the plants now known as Abutilon, unless his meaning is that the fruit resembles a miniature pumpkin in shape; in which case *Abutilon Avicennæ, Gärtn.*, may have been the plant.

Description.—The bark occurs in long, thin, tough, fibrous strips, which are very strong; externally it is striated and covered by a cinnamon-coloured epidermis, internally it is white and striated; the striæ are produced by small interspaces between the fibrous bundles of which the bark is chiefly composed. The taste is feebly astringent and bitter. The seeds of the tomentose variety are reniform, about 1-10th of an inch long, and nearly as broad at the larger end, three in each carpel; testa very hard, dull brown, covered with simple hairs, rising from a conical base, which is attached to the testa by radiating processes like roots. The following is a description of the plant obtained by sowing the Balbij of the shops:—Shrubby, hoary, covered all over with a dense silky tomentum of simple hairs; leaves cordate, unequally and sharply serrated; calyx 5 cleft; pedicels axillary, jointed near the flowers, which are of an orange colour, and open in the evening; capsules truncated, longer than the calyx; carpels about twenty, not awned, hairy on the dorsum. (*A. muticum, G. Don.*)

Chemical composition.—The leaves contain a large quantity of mucilage precipitable with neutral plumbic acetate and ferric chloride, a little tannin or organic acid not affected by gelatine solution, and traces of asparagin. During the ignition of the dried leaves ammonia is evolved in some quantity, and when completely burnt, over 16 per cent. of white mineral residue is left. Nearly half the ash consists of alkaline sulphates and chlorides, and the remainder of magnesium phosphate, calcium carbonate and sand.

Commerce.—The seed is sold by all druggists. Value, Rs. 6 per Surat maund of 37½ lbs.

HIBISCUS ABELMOSCHUS, *Linn.*

Fig.—*Wight Ic., t.* 399. Musk Mallow (*Eng.*), Ketmia Ambrette (*Fr.*).

Hab.—Most tropical countries. The seeds.

Vernacular.—The seeds, Mishk-dánah, Mishk-bhendi-ke-bij (*Hind.*), Kasturi-benda-vittulu (*Tel.*), Káttuk-kasturi (*Tam.*), Kasturi-dána (*Beng.*), Kasturi-bhenda-che-bij (*Mar.*).

History, Uses, &c.—These aromatic seeds are regarded by the Hindus as cooling, tonic and carminative. Arabic and Persian writers notice them under the name of Mishk-dánah, and describe them as Indian, and especially abundant in Bengal; they consider them to be cold and dry, and to have stomachic and tonic properties. The author of the Makhzan-el-Adwiya recommends a mucilage prepared from the root and leaves of the plant in gonorrhœa. The seeds are noticed by Ainslie, who states that in Arabia they are mixed with coffee. He suggests their use as a perfume. Abelmoschus is a corruption of the Arabic name, Hab-el-mishk. The seeds (grains d' ambrette) are largely imported into France from the West Indies by perfumers, who use them as a substitute for musk.

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Description.—The seeds are brown, about 2 lines long, kidney-shaped, slightly compressed, marked with minute parallel elevated lines; they have a small distinct hilum; the odour is purely musky.

Chemical composition.—M. Bonastre, who analysed the seeds, found them to consist of parenchyme and moisture 52, gum 36, alumen 5·6, and fixed oil, solid crystalline matter, odorous principle and resin 6·4 per cent. The fixed oil was greenish yellow, fluid at 32° Fahr., but solidified gradually by exposure to the air. The solid crystalline matter was deposited from the hot alcoholic solution of the seeds; it was white, pearly, of a pleasant taste, soluble in ether, from which it crystallized in rays, fusible at 95° Fahr. The odorous mattter was a light green fluid with a strong smell of musk; it was not volatile.—(*Journal de Pharmacie*, Vol. xx., p. 381.) Messrs. Schimmel of Leipzic give the following description of musk seed oil:—Specific gravity ·900 at 25° C., it solidifies at a temperature below 10° C., and contains a free fatty acid which partially separates even at the ordinary temperature. This acid is not myristic, but probably palmitic acid. In the distillation the oil partially decomposes; the distillate is strongly acid and contains free acetic and fatty acid. The oil after being freed from the fatty acid remains liquid at 0° C. (*Report, October*, 1887.)

Commerce.—The seeds do not appear to be exported from India; those from the W. Indies fetch about 6 pence per lb, at Mincing Lane.

HIBISCUS CANCELLATUS, *Roxb.*,
var. *esculentus, Linn.*

Fig.—*Bentl. and Trim., t.* 36. Esculent Okro, Gombo (*Eng.*), Ketmia comestible (*Fr.*).

Hab.—Cultivated in all tropical countries. The fruit.

Vernacular.—Rám-turai (*Hind.*), Bhenda (*Mar.*), Vendaikkay (*Tam.*), Dheras (*Beng.*), Bhindu (*Guz.*), Bendekai (*Can.*), Benda-káya (*Tel.*).

History, Uses, &c.—It is doubtful whether this plant is a native of India. Sir J. Hooker seems inclined to think that it is. By some it is thought to be the Tindisha of Sanskrit writers, but the name Bhinda occurs in Sanskrit and probably refers to this plant. The Arabs and Persians call it Bámiya; according to Ibn Baitar, Abul-Abbas describes its cultivation and use in Egypt as a vegetable. The Egyptians make a kind of polenta of the cooked, dried, and powdered fruit, called Naffé. The author of the Makhzan-el-Adwiya states that it is called in Bengal Vilayatí-palwal, and in Hindustani Bhendí, and that it is in India considered to be aphrodisiac. The modern Bengali name is Dhéras. Palwal is the *Trichosanthes dioica*, the fruit of which is of a somewhat similar shape to that of *H. esculentus.* In like manner a similarity of shape with the fruit of *Luffa acutangula* (Turai) has given rise to the Hindustani name Rámturai. Mahometan writers describe it as cold and moist and beneficial to people of a hot temperament. Roxburgh considers it to be nourishing as well as mucilaginous, and recommends it as a valuable soothing and demulcent remedy in irritation of the throat caused by coughing. In the Bengal Dispensatory a lozenge is recommended. Finally, in the Pharmacopœia of India, the immature capsules have been made official for the preparation of the decoction, which is intended to be used as an emollient, demulcent and diuretic in catarrhal affections, ardor urinæ, dysuria, and gonorrhœa.

Description.—The fresh immature capsules are from 4—12 inches in length, about an inch in diameter at the base, tapering, furrowed, somewhat bristly, particularly at the ridges, which correspond in number with that of the cells and valves, *viz.*, from 5—8, with a single row of smooth round seeds in each cell, abounding in a copious, bland, viscid mucilage, which exists more or less in all parts of the plant.

Microscopic structure.—The hairs of the fruit are peculiar, the base consisting of one large cell, to which a number of small cells are attached; in the middle and outer zone of the pericarp are large cavities filled with mucilage.

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Chemical composition.—Popp has examined the fresh capsules. He states that they abound in pectin, starch and mucilage. When dried they afforded from 2—2·4 per cent. of nitrogen; and an ash rich in salts of lime, potash, and magnesia. The ripe seeds gave 2·4—2·5 per cent. of nitrogen; their ash 24 per cent. of phosphoric acid. (*Archiv. der Pharmacie*, CXCV., 1871, 142.)

Commerce.—No part of the plant is an article of commerce in India, but the seeds are kept in the shops for sale to gardeners, &c.

HIBISCUS SUBDARIFFA, *Linn.*

Fig.—*Cav. Diss. vi., t.* 198, *f.* 1. Red Sorrell, Rozelle (*Eng.*), Oseille de Guinée, Ketmie acide (*Fr.*).

Hab.—Cultivated in the tropics.

Vernacular.—Patwa (*Hind.*), Lál-ambárí (*Mar.*), Civappukaycurai (*Tam.*), Pundisoppu (*Can.*).

Description.—This plant is cultivated in several parts of India. The fleshy red calyx is used as a fruit, and when dried as an acid article of diet like tamarinds. A jelly not unlike red currant is also made from it. In bilious conditions a diet drink is made by boiling it with water and adding a little salt, pepper, asafœtida and molasses; the French make an astringent syrup with it. The seeds are an excellent food for cattle, and the stems yield tow; the leaves are emollient. The cultivation is attended with very little expense, the seed being sown at the commencement of the rainy reason and the crop ripening at its close. In this plant and in *H. cannabinus* we have the emollient and demulcent properties of the Malvaceæ combined with a large amount of acidity which stimulates and at the same time neutralizes the bilious excretion.

Chemical composition.—The dried calices yielded to analysis—Water 8·29, watery extract 65·96, cellulose 7·68, insoluble

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ash 3·88, soluble ash 2·44, alkalinity of soluble ash as potash ·75, tartaric acid 9·90, remaining free acid as malic acid 15·54—total free acid per 100 parts dry substance 27·44. (*Lyon*, 1882.)

HIBISCUS CANNABINUS, *Linn.*

Fig.—*Roxb. Cor. Pl. i., t.* 190. Hemp-leaved Hibiscus (*Eng.*), Ketmia à feuilles de Chanvre (*Fr.*).

Hab.—Western India. Cultivated in most tropical countries.

Vernacular.—Ambárí (*Mar.*), Pátsan, Rattiasan (*Hind.*), Mesta-pát (*Beng.*), Palungi, Puliccakirai (*Tam.*), Gonkura (*Tel.*), Holada (*Can.*), Sujjádo (*Sind.*).

Description, Uses, &c.—The plant is extensively cultivated for its fibre (Dukhani hemp), and the leaves are used as a potherb. One tola of the juice of the flowers, with sugar and black pepper, is a popular remedy for biliousness. The seeds of this plant yield an edible oil, and would appear to be the Hab-el-zalim of Persia. Haji Zein describes the plant which produces them as like hemp, having white flowers like a mallow with purple stamens, pod prickly, seeds like cardamom seeds, with a black skin and white kernel. He says they are aphrodisiac and fattening. There are two other kinds of Hab-el-zalim, *viz.*, Artichoke seeds, and the fruit of *Habzelia æthiopica*, the Hab-el-zalim of Serapion or Monkey Pepper, formerly used as a substitute for pepper.

THESPESIA POPULNEA, *Corr.*

Fig.—*Wight Ic., t.* 8; *Bedd. Fl. Syl., t.* 63. Portia tree (*Eng.*), Thespésia à feuilles de peuplier (*Fr.*).

Hab.—Tropical shores of Bengal, Ceylon, and both Peninsulas. The bark and fruit.

Vernacular.—Páras-pipal (*Hind.*), Bhendi (*Mar.*), Purasha-maram (*Tam.*), Kandarola-mara (*Can.*), Gangarenu-chettu (*Tel.*), Porash (*Beng.*), Párasa-piplo (*Guz.*).

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History, Uses, &c.—This tree is much valued on account of the toughness of its timber, which is used for carriage building. It is the *Hibiscus populneus* of Rumphius (III. 31), who speaks highly of the value of the heart-wood as a remedy in bilious attacks and colic, and in a kind of pleurodynia from which the Malays often suffer. The fruit abounds in a viscid yellow juice of the colour of gamboge, which the natives use as an external application in psoriasis. The leaves are applied to inflamed and swollen joints. The tree is called in Sanskrit Párisa and Gardhabhánda; it is noticed by Ainslie, who says that a decoction of the bark is given internally as an alterative to the extent of 3—4 ounces twice daily. The author of the Bengal Dispensatory also notices it, but expresses no opinion as to its properties. Several trials with this remedy were made by the Editor of the Pharmacopœia of India in scabies and other cutaneous diseases; in some cases it exercised a favourable influence, but in the majority it was productive of little or no benefit.

According to Braunt (*Animal and Veget. Fats and Oils*) the seeds contain a dark red oil, known as "huile amère" which is stated to be used for medicinal purposes.

Description.—The capsule is about 1½ inch in diameter, oblong, depressed, scaly, ultimately glabrescent, coriaceous, 4-celled, each cell being divided by a partial dissepiment into two parts; seeds the size of a pea, pilose, cotyledons conduplicate, radicle thick, the capsule abounds in viscid yellow juice, which is contained in lacunæ in the inner soft portion. This juice when mixed with water forms a primrose-coloured emulsion, which is not precipitated by oxalate of ammonia, sulphuric acid, chloride of barium, or subacetate of lead. On the addition of Liq. potassæ and alcohol, the emulsion becomes transparent and retains its yellow colour; on the addition of sulphuric acid to the clear potash solution, the colouring matter separates as a curdy precipitate of a greenish yellow colour which floats upon the surface. The heart-wood is of a purplish-red colour and has a pleasant odour; it is very hard,

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but splits readily. It yields hardly anything to water, but forms a deep purplish-red tincture with alcohol, which on evaporation leaves an astringent, brittle extract like kino.

Chemical composition.—The heart-wood of *Thespesia populnea* contains a garnet-red resin which can easily be separated by digesting the wood in diluted alkali and using hydrochloric acid to precipitate it from the filtered solution. The resin is insoluble in water, but perfectly soluble in alcohol, chloroform and the alkalies, and partly in ether and benzol. Its solution in spirit forms a dark greenish-brown colour with ferric chloride, and it is precipitated by lead salts. Water extracts scarcely anything from the wood. It leaves after complete ignition about 3 per cent. of mineral constituents.

BOMBAX MALABARICUM, *DC.*

Fig.—*Wight Ill.*, *t.* 29; *Bedd. Fl. Syl.*, *t.* 82. Red silk-cotton tree (*Eng.*), Bombax de Malabar (*Fr.*).

Hab.—Tropical India. The gum and root.

Vernacular.—Semul, Rakta-semul (*Hind.*), Rokto-semul (*Beng.*), Saur, Sauri (*Mar.*), Mul-ilava-maram (*Tam.*, *Mal.*), Mulluburaga-mara (*Can.*), Mundla-buraga-chettu (*Tel.*), Shemalo (*Guz.*). The gum, Mocha-ras, Supari-ka-phul (*Hind.*, *Bomb.*), Mocha-ras (*Tam.*, *Tel.*, *Can.*).

History, Uses, &c.—*B. malabaricum*, in Sanskrit Sálmali, and Mocha, is a large tree, covered with stout, hard conical prickles, on which account it bears the Sanskrit synonym of Kantakadruma. In the Mahabhárata it is related that Pitámáha after having created the world, reposed under the tree Sálmali, and in the code of Yajnavalkya it is mentioned as one of the trees of the infernal regions (yamadruma), because it makes a great show of flowers, but produces no fruit fit to eat. At the end of the cold season this tree is a very remarkable object, being entirely destitute of leaves, and loaded with large, red, cup-shaped flowers, which are followed

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by egg-shaped, green capsules, containing numerous brown seeds having an average weight of 4-5th of a grain, and a quantity of fine silky cotton. Hindu and Mahometan writers state that the root of the young tree (*músla-semul*), when about as large as a carrot, has restorative, astringent and alterative properties; powdered and mixed with sugar, *ghi* and the juice of the fresh root, it is made into a *pâk* or confection which has a reputation as an aphrodisiac, and as a restorative in phthisis and other wasting diseases. In some parts of India the root of the white-silk cotton tree (*Eriodendron anfractuosum*) is preferred for this purpose. This tree is the *Lanifera arbor* of Clusius, the pods of which were first brought to Holland about the end of the 16th century; its cotton is the Capock fibre of the Dutch, and the tree, like the Bombax, yields a dark-coloured opaque gum, insoluble in water, which is used as an astringent in bowel complaints. The natives regard *E. anfractuosum* as a variety of the Bombax, and call it Sveta-sálmali or "white Sálmali" in Sanskrit. In Hindi it is Safed-semul, in Marathi Pándhra-sáur, in Guzerati Dolo-shemalo, &c., all names which have a similar meaning. In Madras the young fruits are dried and used as a demulcent and astringent. The gum of the Bombax is very astringent, and is used by both Hindus and Mahometans in diarrhœa, dysentery, and menorrhagia in doses of from 40—50 grains for an adult. Sálmali veshta or Mocha-ras (juice of mocha) only exudes from portions of the bark which have been injured by decay or insects; incisions in the healthy bark produce nothing.

Description.—When first exuded it is a whitish fungous mass, which gradually turns red, and finally dries into brittle mahogany-coloured tears. The larger tears are hollow in the centre, the cavity being produced during the gradual drying of the jelly-like mass which first exudes. Dry Mocha-ras when soaked in water swells up, and resumes very much the appearance of the fresh exudation. The taste is purely astringent like tannin.

Mocha-ras is not a normal juice, but the product of a diseased action, which consists in a proliferation of the parenchyme cells of the bark; upon making a section of the diseased part, a number of small cavities are seen, which contain a semi-transparent jelly-like substance, consisting of oblong cells containing a little granular matter and a small group of starch cells. At the margin of the cavity the columns of healthy cells are seen breaking up, and the cells separating to join the jelly-like mass; this gradually increases in size and finds its way to the surface to be extruded as Mocha-ras.

The young roots are of a yellowish white colour when the bark has been removed, and are soft, mucilaginous and feebly astringent; grated and mixed with water they yield abundance of nearly colourless mucilage:

Chemical composition.—Mocha-ras when macerated in water affords a reddish-brown solution, which yields a very copious dirty green precipitate with ferric salts, the solution contains a little gum, which is precipitated by alcohol; the bulk of the exudation remains undissolved.

The seeds of *B. malabaricum* yield 25 per cent. of a sweet non-drying oil; it is of a light yellowish brown colour, and commences to deposit fats at 20° C., when it has a specific gravity of 0·9173. The crystalline insoluble fatty acids of the oil amount to 92·8 per cent., and melt at 41°.

The cake of the seeds of *E. anfractuosum* and that of cotton seeds has been examined by Reinders with the following comparative results:—

	Kapok cake.	Cotton cake.
Water	13·28	12·60
Nitrogenous (albuminous) compounds...	26·84	20·62
Fat	5·82	6·36
Non-nitrogenous extractive matter	19·92	35·42
Woody fibre	28·12	20·36
Ash	6·52	5·64

The ash from Kapok cake contains 28·5 per cent. of phosphoric acid and 24·6 per cent. of potash.

Commerce.—Mocha-ras or Supari-ka-phúl* is collected by Bheels and other wild tribes. It is sold by all the druggists. Value, Rs. 4 per Surat maund of 37½ lbs. The gum of Moringa is frequently mixed with Mocha-ras; though similar in colour, it may readily be distinguished by its weight and solidity.

ADANSONIA DIGITATA, *Linn.*

Fig.—*Cav. Diss. v.*, 298, *t.* 15. Monkey Bread tree (*Eng.*), Calebassier (*Fr.*)

Hab.—Africa. Cultivated in India. The fruit, bark and leaves.

Vernacular.—Gorakh-amli, Háthi-khatiyán (*Hind.*), Gorakh-chinch (*Mar.*), Papparappuli, Anaipuliya-maram (*Tam.*), Sumpura (*Guz.*).

History, Uses, &c.—This tree, remarkable for the enormous size of its trunk, was first described by Aloysius Cadamosto, a Venetian, in 1454, from one he saw growing at the mouth of the Senegal river, which measured 112 feet in circumference. At Senegal it is called El-omarah and Oufa, and the fruit El-kongles. Prosper Alpinus figures it, and notices that the powdered pulp was sold as Terra Lemnia to those unacquainted with the genuine article; it was eaten with sugar as a cooling medicine in febrile disorders. (*For an account of Terra Lemnia, see P. Bellonius, Obs. I.*, 28.) At the present time the pulp is a component of certain pastiles famous in Turkey, and supposed to contain this earth. Adanson, whose name the genus bears, and who travelled in Senegal in 1794, saw two trees, from 5 to 6 feet in diameter, on the bark of which were cut a number of European names; two of these were dated, the one in the 14th, the other in the 15th century. In 1555, the same trees were seen by Thevet, another French traveller, who mentions them in his Travels. Livingstone saw the tree in the neighbourhood of Lake Ngami, where it is called *Mowana*. In India it has been introduced by the Arabians, and is common on the Western Coast and near many Mahometan towns; they call it Bahobab, Habhab or Habhabu. The Indian names Gorakh-amli and Gorakh-chinch, signify Gorakh's tamarind; Gorakh was a celebrated Hindu ascetic. Háthi-khatíyán is Elephant's flax, a name given to the tree on account of the great strength of the fibre prepared from its bark. Mr. A. Rea, of the Archæological Survey of India, describes a curious old tree at Chezala, in the Kistna district, standing in the court of a Buddhist chaitya, which has a hollow core, and is popularly supposed to grow from out of a subterranean cave. It is known as Peruleni-pedda-manu, or "the nameless great tree." Around the base is a platform 25 ft. by 22 ft. 6 in and 3 ft. high. The circumference of the trunk at that height is 53 ft. 6 in; the first branches are 9 ft. 6 in. from the ground, and there the girth is 56 ft. The spread of the foliage is 78 ft. across, and the height of the tree is about 87 ft. In Africa as in India the shell of the fruit is used for various economic purposes, such as floats for fishing nets, water bottles, &c. In Africa the pulp and seeds are used as a food, and as a medicine in dysentery, and the young leaves, which are very mucilaginous, are made into poultices and used as a fomentation to painful swellings. The leaves dried and reduced to powder are called *Lalo* by the Africans, and are used to check excessive perspiration. The Duchassaings of Guadeloupe have recommended the bark in fever: they say it is cooling, lessens the frequency of the pulse, and increases the appetite. It may be given in decoction, 30 grammes in a litre of water, boiled down to two-thirds. (*Corre et Lejanne. Mat. Med. Coloniale.*) Dr. Rançon in his thesis on "La dyssenterie endémique des pays chauds et notamment au Sénégal" (Faculté de Lyon, 1886,) says—"Le

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* Supári is the fruit of *Areca Catechu*, but children masticate instead of it the blunt thorns of *B. malabaricum*, to which they give the name of supári. In this way the gum has come to be called *Supári-ka-phul*, which has misled some into supposing Mocha-ras to be the produce of the Areca.

pain de singe est considéré par les indigènes comme le médicament anti-dyssentérique par excellence. Il est mélangé aux aliments mêmes. Ainsi, l'indigéne se nourrit surtout de bouillie de farine de mil avec du lait caillé. On désigne ce mélange sous le nom de *Sanglé*. Lorsqu'il est atteint par la dyssenterie, le nègre mélange le pain de singe à cette bouillie."

Dr. Garnier in his thesis "Souvenirs médicaux du poste du Sedhion (Cazamance)" Faculté de Montpellier, 1888, says of the Baobab: "Il est utilisé dans l'alimentation par les noirs, qui l'ajoutent au couscous; dans la thérapeutique, par les mulâtres, contre la diarrhée ou la dyssentérie. Il nous a été loisible de l'expérimenter plusieurs fois dans la première affection, et si nous n'avons pas relevé d'action efficace bien marquée, nous ne lui avons pas trouvé non plus d'inconvénients. Il nous a paru agir comme substance rafraîchissante, tempérante, *se rapprochant du tartrate de potasse*. Quelque peu de pulpe en macération dans l'eau donne une tisane fort agréable et calme bien la soif, dans la fièvre, par exemple. Ses feuilles sont mucilagineuses et émollientes, on les emploie fraîches ou sèches. Sous cette dernière forme, c'est le *Lalo* des nègres. Étant au bout de notre provision de tourteaux de graines de lin, nous nous en sommes maintes fois servi avec succès, suivant le conseil d'un commercant de Sedhion, pour remplacer l'émollient Européen." In India the pulp mixed with buttermilk is used as an astringent in diarrhœa and dysentery. In the Concan the pulp with figs is given in asthma, and a sherbet made of it, with the addition of cummin and sugar, is administered in bilious dyspepsia. It is also given for this affection with emblic myrobalans, fresh mint, rock salt and long pepper. Modern research shows that the pulp is aperient and demulcent, the leaves demulcent with slight astringency and the bark demulcent and astringent, the astringency being due to the presence of tannin.

From an article in the "Bulletin de la Société Philomatique de Paris (1822, p. 103,) it would appear that the pulp of the Baobab was used in Europe up to the commencement of the

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present century as a remedy for dysentery. The ash of the pericarp is used in Africa for the manufacture of soap.

Description.—The fruit varies much both in shape and size; some specimens correspond with the description given by Adanson, and others with that of Guibourt, that is to say, they are either cucumber-shaped or bottle-shaped, and from 6 to 18 inches in length. The shell is hard, woody and light, clothed with a dull green felt-like down, composed of simple hairs; it is made up of regularly arranged wood cells intersected here and there by vascular bundles. The fruit is full of sub-acid pulp, which is divided by fibrous bands into a number of compartments. The pulp dries up into a starch-like powder of a reddish-white colour, which adheres together in polyhedral masses, a seed forming the centre of each mass; it consists chiefly of mucilage-cells and contains no starch. The seeds are enclosed in a horny shell, having a rusty-red, rough exterior; they are kidney-shaped and half an inch in length. The bark has a scabrous epidermis, and on section shows a mottled yellowish-green and reddish-brown surface; internally it is intimately united with the woody fibre of the trunk. The fresh bark when wounded yields a white semi-fluid gum, which is odourless and tasteless, and has an acid reaction; it is insoluble in water. The ash contains a large quantity of lime. Mr. J. G. Prebble has brought to our notice that this gum when examined under the microscope is seen to be full of well-formed clustered crystals of calcium oxalate; there are also some highly refractive globules of oil or oleo-resin. With age the gum eventually becomes reddish-brown.

Microscopic structure.—A transverse section of the leaf shows that the upper surface consists of a single row of large cells, which swell when boiled, but develop no mucilage. Beneath this is a parenchyme of cells containing chlorophyll, except over the central nerve, where chlorophyll is absent and the cells are broken down to form a large lacuna or depôt of mucilage; similar cells and smaller lacunæ are seen beneath the nerve to the number of four or five. Over the secondary nerves there are similar cells and a single lacuna. The rest of the parenchyme is cellular and of no special interest. The lower surface of the leaf is composed of a row of small cells which yield no mucilage on boiling.

A transverse section of the young stem shows an epidermis and scanty suber, beneath which are a number of rows of tangentially extended cells, and then two or three rows of parenchyme cells containing chlorophyll and oil globules, amongst which are some cells containing crystals of calcium oxalate. Next comes a thick liber, in which are groups of stone cells and some cells containing calcium oxalate. The wood is porous, and the pith also shows cells containing oxalate. In the old bark, in the cells beneath the chlorophyll cells, are tangentially extended lacunæ containing mucilage, which absorb a large part of the tissue; the suber and liber are much developed, and large groups of stone cells are seen in connection with the medullary rays. (*Heckel and Schlagdenhauffen.*)

Chemical composition.—Mixed with water and treated with a drop of iodised iodide of potassium, the pulp is not coloured blue or yellow, showing the absence of starch and albumenoid principles, but the water forms a mucilage which, when filtered and treated with alcohol, yields an abundant gelatinous precipitate. It is also precipitated by neutral plumbic acetate, chloride of zinc, ferric chloride, and the chlorides of barium, strontium, and lime. The watery solution has an acid reaction, and when treated with nitric acid yields mucic and oxalic acids. The pulp exhausted by petroleum ether affords a light yellow extract, which contains traces of resin, is insoluble in water, and is not coloured by ferric chloride; chloroform removes from it a similar extract, but of a greenish colour, owing to the presence of a trace of chlorophyll. The alcoholic extract is of a reddish-brown colour and partly soluble in water; the insoluble portion re-dissolved in alcohol is coloured bluish-green by ferric chloride; the soluble portion is coloured red by the same reagent, and reduces freely Fehling's solution. According to Heckel and Schlagdenhauffen, the following is the composition of the pulp:—

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Principles soluble in petroleum ether and chloroform	0·0530		
Principles soluble in alcohol	9·9783	2·4370	phlobaphenes
		5·5753	glucose
		1·9660	tartaric acid and traces of alkaline acetate
Principles soluble in water	51·2840	8·8397	glucose
		33·6623	mucilage and gum
		11·7820	bitartrate of potash
Ash by difference	35·6847	32·2350	woody and colouring matter
		3·4497	salts
	100·000	100·000	

The pericarp of the fruit according to Heckel and Schlagdenhauffen contains:—

Water	12·176
Alcoholic extract: colouring matters, albuminoids, phlobaphene.	3·860
Watery extract: albuminoids, colouring matters, salts, and gummy matters	7·357
Ash: fixed salts, chiefly carbonate of potash and soda	5·258
Woody tissue (by difference)	71·258
	100·000

The leaves examined by the same chemists were found to have the following composition:—

Soluble in petroleum ether	Wax	1·450
Soluble in alcohol	Glucose	1·625
	Wax	3·245
	Salts	0·755
	Undetermined matters	2·225
Soluble in water, gummy and albuminous matters		20·31
Ash, chiefly chloride of sodium, and carbonates of potash and soda		4·55
Lignin, by difference		65·84
		100·00

Messrs. Heckel and Schlagdenhauffen found no trace of an alkaloid in the bark, nor of any such substance as saponin, or the adansonin of Wittstein and Walz. Its composition was—

Soluble in petroleum ether	Wax	0·425
Soluble in alcohol	Wax	3·0375
	Insoluble tannin	2·2925
	Soluble tannin	0·7825
	Chloride of sodium	0·08
Soluble in water, gummy and albuminous matters		1·35
Ash, chiefly chloride of sodium and carbonates of potash and soda		6·2905
Lignin, by difference		85·742
		100·00

—(*Les Nouveaux Remèdes*, 1888, *pp.* 385, 481.)

PAVONIA ODORATA, *Willd.*

Fig.—*Wall. Cat.* 1886, 1, 2. *D.*, *E.*

Hab.—N.-W. Provinces, Sind, W. Peninsula, Burmah, Ceylon.

Vernacular.—Sugandha-bala (*Hind.*), Bala (*Beng.*), Káláválá (*Mar.*), Perámútiver (*Tam.*), Bálarakkasi-gida (*Can.*).

History, Uses, &c.—This plant is called Bala and Hrivera in Sanskrit. The root is used in Hindu medicine to prepare a fever drink known as *Shadanga paniya*, which is made by boiling one drachm each of the roots of *Andropogon muricatus* and *Cyperus rotundus* or *pertenuis*, Red Sandalwood, the herb of *Oldenlandia herbacea*; the roots of *Pavonia odorata*, and dry ginger, in two sérs of water down to one sér. It is considered to be cooling and stomachic. The genus Pavonia is named after Don Josef Pavon, a botanical traveller in Peru. Ainslie (*Mat. Med. ii.*, 297;) notices the use of *P. odorata* by the Hindus, but expresses no opinion as to its medicinal properties. In Bombay, Serpentary root imported from Europe, is universally substituted for this drug. In *P. odorata*, as in the Musk Mallow, the mucilaginous properties of the genus are combined with an odorous matter having the stimulating and carminative action of musk.

Description.—Roots 7 to 8 inches long, more or less twisted, not more than ¼ inch in diameter at the thickest part; giving off numerous thin fibres and having a delicate musky odour. Bark light brown, nearly smooth, wood hard, yellowish. The plant has the musky odour of the roots; it is herbaceous, erect, and covered with sticky hairs. Flowers pink; carpels obovoid, size of a small pea; seeds brown, oily, not musky.

GOSSYPIUM STOCKSII, *Mast.*, var. herbaceum, *Linn.*

Fig.—*Wight Ic.*, *t.* 9, 11; *Royle Ill.*, *t.* 23. Cotton plant (*Eng.*), Cotonnier (*Fr.*).

Hab.—Sindh. Cultivated in most hot countries.

Vernacular.—Kapás (*Hind.*, *Mar.*), Vona (*Guz.*), Paruthi (*Tam.*), Hatti-gida (*Can.*), Karpás (*Beng.*), Patti-chettu, Kárpásamu (*Tel.*).

History, Uses, &c.—Cotton, the Karpási of Sanskrit writers, was doubtless first known and made use of by the Hindus; it is the βυσσος of the later Greek writers, such as Philostratus* and Pausanias,† but not of the earlier Greeks, who applied this term to a fine kind of flax used for making mummy cloths. Theophrastus‡ calls it Eriophora, Pliny Gossympinus, Gossypion, and Xylinum.§ In Arabic cotton is called قطن and قرفس (Ḳuttun and Kurfus), the latter term being evidently derived from the Sansḳrit. Eastern physicians consider all parts of the cotton plant to be hot and moist; a syrup of the flowers is prescribed in hypochondriasis on account of its stimulating and exhilarant effect; a poultice of them is applied to burns and scalds. Cotton cloth or mixed fabrics of cotton with wool or silk are recommended as the most healthy for wear. Burnt cotton is applied to sores and wounds to promote healthy granulation; dropsical or paralysed limbs are wrapped in cotton after the application of a ginger or zedoary *lép* (plaster); pounded cotton seed, mixed with ginger and water, is applied in orchitis. Cotton is also used as a moxa, and the seeds as a laxative, expectorant, and aphrodisiac. The juice of the leaves is considered a good remedy in dysentery, and the leaves with oil are applied as a plaster to gouty joints; a hip bath of the young leaves and roots is recommended in uterine colic. In the Concan the root of the *Deokapás* (fairy or sacred cotton bush) rubbed to a paste with the juice of patchouli leaves, has a reputation as a promoter of granulation in wounds, and the juice of the leaves made into a paste with the seeds of *Vernonia anthelmintica* is applied to eruptions of the skin following fever. In Pudukota the leaves ground and mixed with milk are given for strangury.

Cotton root bark is official in the United States Pharmacopœia, also a fluid extract of the bark; it appears to have first attracted

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* 71. † VI., 26. ‡ II. P. IV., 9. § 19, 2.

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attention from being used by the female negroes to produce abortion. There appears to be little doubt that it acts like ergot upon the uterus, and is useful in dysmenorrhœa and suppression of the menses when produced by cold; a decoction of 4 ounces of the bark in two pints of water boiled down to one pint may be used in doses of two ounces every 20 or 30 minutes, or the fluid extract may be prescribed in doses of from 30 to 60 minims. Cotton seed tea is given in dysentery in America; the seeds are also reputed to be galactagogue. (*Stillé and Maisch., Nat. Disp., p.* 678.) By treating cotton first with a dilute alkali, then with a 5 per cent. solution of chloride of lime, and lastly with water acidulated with hydrochloric acid, and afterwards well washing it with water, it loses its greasiness and becomes absorbent and a valuable dressing for wounds; this absorbent cotton may be medicated by sprinkling it with solutions of carbolic acid, salicylic acid, boracic acid, &c. Pyroxylin or Gun Cotton is made by dipping cotton into a mixture of equal parts of nitric and sulphuric acids, washing freely with water, and drying.

Description.—Cotton root bark is in bands or quilled pieces, one half a line thick, covered with a brownish-yellow, satiny, very thin cork, by the abrasion of which irregular, dull, brownish orange patches appear. The cork forms slight longitudinal ridges, which are often confluent into elongated meshes, and marked with black circular dots or short transverse lines. The inner surface is whitish or reddish white, of a nearly silky lustre, and finely striate in a longitudinal direction by the thin medullary rays. The bast fibres are long and tough, arranged in tangential rows, and are separated without difficulty in very thin layers. The bark breaks with difficulty in a transverse direction, but is readily torn longitudinally. It is without odour and without taste, with the exception of a very slight acridity and faint astringency. (*Stillé and Maisch.*)

Chemical composition.—The bark contains *starch*, and when fresh, according to W. A. Taylor (1876), a *chromogen*, which dissolves in alcohol with a pale yellow colour, gradually changing to a bright brownish-red. The same change takes place on keeping the bark for some time, when it yields a red tincture with alcohol. This substance was examined by Prof. Wayne (1872) and W. C. Staehle (1878), who regard it as of a resinous nature. The latter obtained about 8 per cent. of this substance, which is soluble in 14 parts of alcohol, 15 of chloroform, 23 of ether, and 122 of benzol; also in alkalies, from which solutions it is again precipitated by acid. The potassa solution diluted with water is of a sage green tint. Glucose was likewise observed, and the aqueous solution of the alcoholic extract contained a principle which gave a purplish-black precipitate with ferric chloride. C. C. Drueding (1877) obtained also a yellow resin soluble in petroleum-benzine, a fixed oil, a little tannin and 6 per cent. of ash. (*Stillé and Maisch.*) Cotton seeds are small in size, and vary from ellipsoid to fusiform, and in colour from pale grey through yellow and brown to almost black. Of forty samples examined the amount of oil varied between 10 per cent. in an immature and badly dried Sea Island seed, to 29 per cent. in fully matured Egyptian seed. The albuminoids and other nitrogenous substances varied from 18 to 25 per cent., and the lignin from 15 to 25 per cent. One hundred pounds of seed give on an average—

Hills with lint	49—46	pounds.
Cake	38—37	,,
Oil	16—14	,,

The crude oil has 28 to 30 times the viscosity of water. At 20° C. it has a specific gravity of ·9283 and at 15° C. of ·9306. It congeals at —1°·9 C. to —2°·7 C. In taste and odour it resembles linseed oil, and in other properties it is intermediate between a drying and a non-drying oil. The refined oil has a specific gravity of ·9264 at 15° C. and congeals at ·0°C. to —1·°1 C. Chemically cotton seed oil consist of palmatin and olein, and its ultimate percentage composition is carbon 76·40, Hydrogen 11·40, Oxygen 12·20. (*Brannt.*) Cotton seed oil is not suitable for pharmaceutical purposes.

Commerce.—Cotton root bark is not an article of commerce in India; it may be obtained fresh in most parts of the country. Cotton seed oil is largely manufactured in the United States; in 1888 the Atalanta mills pressed 15,000 tons of seed, obtaining 4,668,750 pounds of oil, worth 30 cents a gallon, or 7½ lbs.

The meal obtained was 10,331,250 lbs. and 300,000 lbs. of lint cotton were removed from the seeds before expressing the oil. The lint was worth 18,000 dollars, and the meal which is used as a manure 88,603,58 dollars.

The following plants belonging to the Malvaceæ are also used medicinally on account of their mucilaginous properties :—

Hibiscus tiliaceus, *Linn.*, **Malva parviflora**, *Linn.*, **Malachra capitata**, *Linn.*, **Urena lobata**, *Linn.*, and **Kydia calycina**, *Roxb.* The bark of the last named plant is used in sugar refinery. It is a remarkable bark abounding in gum; the gum comes from the liber, where the layers may be separated like pieces of lace; on scraping away the outer layer, the gum is seen protruding between the longitudinally disposed fibres. In the *Pharmacographia* it is stated that Althæa gum occurs in cells; in this bark it appears to be formed from cellulose, as the cells seem to be disrupted, and the cell walls absorbed.

STERCULIACEÆ.

STERCULIA URENS, *Roxb.*

Fig.—*Roxb. Cor. Pl. I.* 25, *t.* 24.

Hab.—Throughout India, Ceylon. The gum.

Vernacular.—Bali, Gúlú, Kúlú, Karai, Kalru (*Hind.*), Karai (*Guz.*), Pándrúk, Kávali, Kandúl (*Mar.*), Penári (*Can.*), Kávali, Tabsu (*Tel.*), Vellay-putali (*Tam.*).

History, Uses, &c.—It is uncertain whether this tree is mentioned by Sanskrit writers, as it appears to have been confounded with *Cochlospermum Gossypium*, which yields a similar gum. Possibly it may be the tree spoken of as Bâlika. The gum is collected for sale in most parts of India, and is largely used for making native sweetmeats, and as a substitute for tragacanth. The seeds yield an oil containing much stearin (*Hawkes*), and are eaten by the Ghonds and Kukus in the Central Provinces. (*Brandis.*).

It has been shown by Van Tieghem that "in the Sterculiaceæ the gum is produced in large secretory cells formed by the separation of contiguous cells. These cells surrounding the canals are surrounded by smaller cells, which become dissociated as the canal enlarges, and so altered in appearance as to be scarcely recognizable. In *Cola acuminata* the gum canals are present in the pith and bark." (*Bull. Soc. Botanique de France*, p. 11, and *Pharm. Journ.* (3), xv., 893.)

Description.—On cutting off a young branch of *Sterculia urens* the gum is seen exuding as a soft solid mass from very large canals in the pith and bark, and it appears to be contained in the tissues with some tension as the gum is extruded in a short time to the extent of about half an inch. The very young portions of the trees, as the branches of the panicled inflorescence and the petioles of the leaves also extrude the gum. The gum is completely soluble in cold water, forming an almost colourless solution. Seen in volume it is slightly opalescent. Thirty grains dissolved in twenty ounces of water forms a thick, tasteless, mucilage, which entirely passes through a paper filter. A solution of this strength, examined in a column 200 m.m. long, was optically inactive, neutral to litmus, and not precipitated by alcohol. A very thick mucilage is, however, precipitated. It is gelatinized by basic acetate, and gives a faint precipitate with neutral acetate of lead, but is unaffected by ferric chloride or borax and not coloured blue by iodine. It is precipitated by boiling with an alkaline solution of cupric tartrate, but the copper is not reduced. The gum treated with nitric acid yields abundant crystals of mucic acid. It loses 16 per cent. of water by drying at 100° C., and on incineration yields about 4 per cent. of ash. Examined under the microscope, no starch can be detected, but a few small polygonal parenchyme cells are usually to be met with. The mucilage possesses little or no adhesive power.

From some comparative experiments made with cod-liver and castor oils it appears to be about equal to tragacanth as an emulsifying agent. (*J. G. Prebble.*)

Commerce.—The gum exudes most abundantly in the cold weather, and is collected by the forest tribes. Value about Rs. 12 per cwt.

In China the fruits of **Sterculia scaphigera**, *Wall.*, are used on account of the large quantity of gum, which they contain under the name of *Ta-hai-tsze.* They were introduced into France as a cure for dysentery under the name of *Boa-tam-paijang*, but were found to act simply as a demulcent. These fruits are from ¾ to 1½ in. long, ovoid, usually somewhat elongated at the lower extremity, which terminates by a large oblique cicatrix. Externally they are of a dark-brown, deeply wrinkled, though generally less so at the superior extremity. The pericarp, which is from $\frac{1}{10}$ to $\frac{1}{20}$ of an inch in thickness, consists of a thin epidermis, beneath which lies a dry, black, resinous-looking pulp, surrounding a fragile shell lined with a whitish membrane. The central portion of the fruit is occupied by two cotyledons, which in their dried state are thin and concave. When the fruit is macerated in water, its outer shell, or pericarp, increases enormously in volume, forming a large gelatinous mass. (*See Hanbury's Science Papers, p. 235, where a figure of the fruit will be found.*) Guibourt found in the pericarp, green oil 1·06, bassorin 59·04, brown astringent matter and mucilage 1·60, woody fibre and epidermis 3·20; and in the nucleus, fatty matter 2·98, saline and bitter extractive 0·21, starch and cellular tissue 31·91 per cent.

Several species of sterculia afford large oily seeds, which are eaten by the natives. Of these, *S. fœtida, Linn.*; *Wight Ic.*,

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t. t. 181, 364, may be taken as a type. It is a large tree of the Western Peninsula, Concan, Malabar, Burma, and Ceylon, and is often called "wild almond" in the vernaculars. The Tamils also call it Kudrap dukku, from the resemblance of its large follicle to the testicles of a horse. The seeds are elliptic, about an inch long, and half an inch in diameter, covered with a loose black parchment, and having a yellow caruncle at the base. A white felt-like layer covers the hard black shell, which is brown and velvety within, and encloses an oily white kernel of the same shape as the seed. Each seed weighs about two grams. The shells are difficult to powder. The felt-like skin softens in water like bassorin. The kernels contain about 40 per cent. of fixed oil and a large quantity of starch.

Loureiro states that the bark of this tree is aperient, diaphoretic, and diuretic, and is given in dropsy and rheumatism by the Chinese. The flowers are remarkable for their stercoraceous odour.

The fixed oil of *Sterculia fœtida* is thick, pale yellow, bland, and non-drying. It commences to deposit crystalline solid fats at 18° C., and the whole congeals at about 8°. The specific gravity at 15·5° is ·9277. Saponification equivalent 266·2. The crystalline fatty acids melt at 29° to 30°. With sulphuric acid it forms a thick orange-red mixture. With cold nitric acid it becomes opaque and slightly deepens in colour; when heated with the acid, it changes to a deep coffee-brown. The portion of the lead soap of the fatty acids, insoluble in ether, amounted to 68·9 per cent., and the liberated acid without any purification had a melting point approximating that of stearic acid. The fatty acids from the lead soap, soluble in ether, consisted of oleic with a small quantity of lauric acid.

HELICTERES ISORA, *Linn.*

Fig.—*Wight Ic.*, *t.* 180; *Rheede Hort. Mal. vi.*, *t.* 30. East Indian Screw tree (*Eng.*).

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Hab.—Central and Western India and Western Peninsula, Ceylon. The fruit and root.

Vernacular.—Marori, Marorphali (*Hind.*), Mriga-shinga (*Guz.*), Kevani, Varkáti, Dhámani (*Mar.*), Valumbirikai (*Tam.*), Atmorha (*Beng.*).

History, Uses, &c.—This is a tall shrub, or small tree, much resembling the common hazel; the flowers, which are bright red and showy, appear in the rains. In Sanskrit it is called Avartani and Mriga-shinga or "deer's horn." The peculiar twisted form of the carpels has probably led to its use as a medicine according to the ancient doctrine of signatures. Ainslie notices its use by the Hindus as a remedy for offensive sores inside the ears. At the present time it enters into most prescriptions for the cure of griping in the bowels and flatulence, especially in the case of children. Its chief virtue seems to be its harmlessness. It is indispensable at the marriage ceremonies of the Vaisya caste, being tied upon the wrist of bride and bridegroom along with the fruit of *Randia dumetorum.* Persian names for it are Kisht-bar-kisht and Pechak. It is the Kisht-bar-kisht of Ibn Sina, who describes it as hot and dry in the third degree. In the Concan the root-bark is prescribed in diabetes. We have been unable to discover that this plant has any properties beyond those of a demulcent and wild astringent. The roots may be used as a substitute for althæa.

Description.—The fruit consists of five slender angular carpels, twisted like a corkscrew, and together forming a cone about 1½ to 2 inches long. The carpels are pubescent, and of a greenish brown colour; they contain a single row of dark brown angular seeds. The internal surface is of a light greenish hue and highly polished; taste mucilaginous. The root bark is of a dark-brown colour, and is very thickly studded with small round warts so as to present almost the appearance of Shagreen.

Commerce.—The fruit is kept in all druggists' shops, and as a domestic remedy is perhaps one of the best known articles in the Hindu Materia Medica. Value, Rs. 3½ per Surat maund of 37½ lbs.

Pterospermum suberifolium, *Lam. Ill., t.* 576, *f.* II., Muchkand (*Hind.*), bears white fragrant flowers, which rubbed into a paste with kángika (rice vinegar) are an ancient and well known Hindu remedy for hemicrania. The Sanskrit name of the plant is Muchukunda, which appears to be derived from मुचु, Greek μυσσω; Latin mungo, whence mucus, and कुन्द a sweet-smelling flower. The flowers render water gelatinous.

P. acerifolium, another species, is called in Sanskrit Karnikára, in Hindi Kaniár and Katha-champa, and in Bengali Kanakchampa. In Sikkim it is known as Hathipaila, and the hill people use the white tomentum from the under surface of the leaf to stop bleeding. In the Concan the flowers and bark of these trees are charred and mixed with Kamala, and applied in suppurating small-pox. Karnikára is mentioned by Kálidása as "a flame of the woods." The tree he alludes to is evidently *Cassia Fistula,* which also bears this name in Sanskrit.

ABROMA AUGUSTA, *Lam.*

Fig.—*Lam. Ill., t.* 636 *and* 637. Devil's Cotton (*Eng.*).

Hab.—India and the East. Native or cultivated. The root.

Vernacular.—Ulat-kambal (*Beng.*), Olak-tambol (*Bomb.*)

History, Uses, &c.—This shrub has long been known as a plant yielding a valuable fibre (*Royle's Fibrous Plants of India,* p. 267). In 1872, Mr. Bhoobun Mohun Sircar (*Ind. Med. Gaz.*) first called attention to the use of the root as an emmenagogue in Bengal, and recommended the fresh viscid sap in the treatment of dysmenorrhœa in doses of 30 grains. Subsequently Dr. Kirton recommended the use of drachm doses of the root

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beat into a paste with water. Dr. Watt in his "Dictionary of the Economic Products of India" records the opinion of thirteen medical men regarding the medicinal properties of the plant; of these, eight speak favourably of it. Dr. R. Macleod says;—"It is a valuable medicine in dysmenorrhœa, the fresh root is usually given, made into a paste with black pepper about a week before the time of menstruation, and is continued until it commences. I have seen it prove very efficacious in some cases, especially in the congestive form of the disease." Dr. Thornton says:—"The slender roots are useful in the congestive and neuralgic varieties of dysmenorrhœa. It regulates the menstrual flow and acts as a uterine tonic. It should be given during menstruation, 1½ drachms of the fresh root for a dose with black pepper, the latter acting as a stomachic and carminative." Dr. Evers says:—"It has never failed in my hands in speedily relieving painful dysmenorrhœa." In Western and Southern India the plant is not common, and its medicinal properties do not appear to be known.

Description.—A small tree or shrub, with soft velvety branches, and ovate-oblong, serrulate leaves, the under surface of which is tomentose. The flowers are dark purple and drooping, and have five petals with dilated claws. The fruit is a dry, 5-celled capsule, with 5 truncated wings. When ripe it dehisces at the apex, exposing the five inner angles of the cells crested with stiff silky hairs which penetrate and irritate the skin if handled. Each cell contains numerous black seeds the size of radish seeds. The roots have a thick, fibrous, brown bark, which, when freshly cut, protrudes a thick gummy substance like others of the genus. (*See Sterculia urens.*)

Chemical composition.—The bark was separated from the dried roots and reduced to powder. Dried at 100° C. the powder lost 5·37 per cent. of moisture. The ash calculated on the undried powder amounted to 11·64 per cent. There was nothing special to note regarding the composition of the ash; it did not contain manganese.

Treated with light petroleum ether 0·4 per cent. of a yellow soft extract was obtained, which was odourless and tasteless. In cold alcohol it was partly soluble, the solution possessing an acid reaction, and leaving on spontaneous evaporation an indistinctly crystalline residue. The portion insoluble in cold alcohol was white and had the physical properties of a wax.

After the action of petroleum ether, the powder was dried and exhausted with ether, which yielded on evaporation ·88 per cent. of yellow odourless non-crystalline extractive. This extract was insoluble in water and in dilute acids. In alcohol it was partially soluble with acid reaction. In alcoholic ammonia the extract was almost wholly soluble, the solution being of a yellow colour: the addition of acids to the ammoniacal solution caused the separation of whitish flocks. The ether extract gave no reaction with iron salts.

After removal of ether from the powder, it was treated with absolute alcohol, and on evaporating off the spirit 1 per cent. of a yellow non-crystalline extract was left. This extract was slightly soluble in water, with acid reaction; by the action of dilute sulphuric acid, a yellowish solution was obtained, and a yellow insoluble residue left. The acid solution did not give any reaction with alkaloidal reagents. The residue insoluble in dilute acid was wholly soluble in aqueous ammonia, the resulting solution being of a deep yellow colour: the addition of acids caused the precipitation of yellowish white flocks which were easily soluble in chloroform. A portion of the original alcoholic extract gave no reaction with iron salts. The powder after exhaustion with alcohol was dried. When treated with water the dry powder formed a viscid mass; by the action of boiling water the mucilage partly dissolved, the solution did not gelatinize on cooling. A trace of starch was present.

PENTAPETES PHŒNICEA, *Linn.*

Fig.—*Rheede, Hort. Mal. x.*, t. 56; *Cav. Diss.* iii., t. 43, *f.* 1.

Hab.—Throughout the hotter parts of India.

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Vernacular.—Dopahariya (*Hind.*), Kát-lálá, Bándhuli (*Beng.*), Tambri-dupári (*Mar.*), Nága-pú (*Tam.*)

A large annual (4 to 5 ft.) found in rice-fields and other wet places during the monsoon. It is the Naga-pu of Rheede. The capsules of this plant are used medicinally on account of their mucilaginous properties; they are subglobose, bristly, 5-celled, 5-valved, about half the length of the persistent interior calyx, which is 5-partite and bristly. Each cell contains from 8 to 12 seeds arranged in two vertical rows. (*See Gärtn. Fr., t.* 134.) The plant appears to have attracted the attention of the Hindus on account of its peculiar habit and time of flowering, and has many Sanskrit names, such as Bandhuka and Bandhujiva, living in association or groups; Arka-vallabha, beloved of the sun; Pushparakta, red-flowered, &c.

TILIACEÆ.

CORCHORUS TRILOCULARIS, *Linn.*

Fig.—*Jacq. Vind.* 2, *t.* 173. Trilocular Jew's Mallow (*Eng.*), Corete triloculaire (*Fr.*).

Hab.—Asia, Africa. The seeds.

Vernacular.—Kurrú Chuntz (*Mar.*), Pát (*Hind., Beng.*), Peratti-kirai (*Tam.*), Parinta (*Tel.*). The seeds, Raja-jíra (*Guz.*).

History, Uses, &c.—*C. trilocularis* is a small annual plant which appears in the rainy season along with *C. olitorius*, from which it may be distinguished by its oblong, lanceolate leaves, trilocular capsules, and small seeds; both plants are known by the name Nádika in Sanskrit. Ainslie mentions the latter plant as being used medicinally by the Hindus, and says that they reduce it to ashes and mix it with honey for administration in obstructions of the abdominal viscera. He also notices its use as a pot-herb. According to Twining, an infusion of the leaves forms a useful fever drink. In India the seeds of *C. trilocularis,* which are bitter, are administered in doses of about 80 grains in fever and obstructions of the abdominal viscera. A bitter corchorus was known to the Greeks. Theophrastus says *ὁ παροιμιαζόμενος διὰ τὴν πικρότητα κόρχορος.* (H. P., VII. 7.) Pliny (21, 106) also mentions Corchorus as a poor kind of pulse growing wild.

Description.—The seeds, which are closely packed in the trilocular capsule, are small, black and angular; they are generally more or less mixed with those of *C. olitorius,* which may easily be distinguished by their greater size ($\frac{1}{10}$th of an inch) and peculiar shape, which resembles that of a mooring buoy.

Corchorus fascicularis, *Lam.,* a native of tropical India, Australia and Africa, is a small procumbent woody plant with oblong or lanceolote serrated leaves; peduncles 2—5 flowered, opposite to the leaves; capsules linear oblong, nearly terete, rostrate, three-celled, about half an inch long, clothed with simple hairs; they contained a number of small dark-brown angular seeds. The whole plant is sold in the shops; it is very mucilaginous and somewhat astringent, and is valued as a restorative. Hiran-khorí is the name given to it by the country people, and means deer's hoof. In the Calcutta and Bombay shops it is called Bhaphalí, which name must not be confounded with Bhaphalí, the Marathi name for *Peucedanum grande,* an umbelliferous plant.

C. fascicularis has been received from Poona under the name of *Magarmithi. C. Antichorus, Ræusch., Wight Ic.* 1073, is also sold as Baphalí.

GREWIA TILIÆFOLIA, *Vahl.*

Fig.—*Beddome, Fl. Syl., t.* 108.

Hab.—Western India to the Himalayas, Burma, Ceylon.

Vernacular.—Dhámaní (*Hind., Beng.*), Dhámán (*Mar.*), Thada, Tharra (*Tam.*), Charachi (*Tel.*), Butale (*Can.*).

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History, Uses, &c.—A tree, leaves hoary beneath, oblique cordate, dentate, 5-nerved, feather veined, petioles 1 inch, pubescent, thickened at the top, stipules leafy, falcate acuminate, auricled on one side, flowers yellow. The berries have an agreeable acid flavour and are eaten. Bark thick, white internally, covered externally by a thin grey suber which readily peels off, showing a slightly rough, green surface beneath, very mucilaginous and sweetish to the taste. In the Concan the bark, after removal of the suber, is rubbed down with water and the thick mucilage strained from it and given in 5 tolá doses with 2 tolás of the flour of *Panicum miliaceum*, as a remedy for dysentery. The Sanskrit name of the tree is Dharmana, and this name is loosely applied to several species of Grewia.

The bark of **G. asiatica**, *Linn.*, has similar properties. The tree is called Parusha in Sanskrit, Phalsa in Hindi, Shukri in Bengali, Phalshi in Marathi, and Putiki in Telugu. It is cultivated for its acid fruit, which is one of the *phala-traya* or fruit triad of Sanskrit writers. (See *Pomegranate.*)

Grewia scabrophylla, *Roxb.*, with scabrous leaves, stem and fruit, Khatkhati (*Mar.*), is given in accordance with the doctrine of signatures as a remedy for leprosy in the Concan; it appears to be simply mucilaginous like most of the genus. Its roots are the althéa of the Portuguese in Goa, and are used as a substitute for Althæa.

Triumfetta.—The plants belonging to this genus are mucilaginous, and are used as demulcents.

The burr-like fruit is said to promote parturition. **T. rhomboidea**, *Jacq.*, often confounded with *Sida* (see *Malvaceæ*) by the natives, is generally used. The plants of this genus are the Lappuliers of the French colonies, and bear the significant names of *Herbe à cousin*, *pou de moine*, and *tête à nègre*.

LINEÆ.

LINUM USITATISSIMUM, *Linn.*

Fig.—*Bentl. and Trim.*, *t.* 39. Common Flax (*Eng.*), Lin usuel (*Fr.*).

Hab.—Egypt. Cultivated in India. The seeds and oil.

Vernacular.—Alsí, Tisí (*Hind.*), Alishi-virai (*Tam.*), Mosiná (*Beng.*), Alashi, Javas (*Mar.*), Atasi, Madana-gingelu (*Tel.*), Alashi (*Can.*).

History, Uses, &c.—Linseed, called in Sanskrit Atasí, appears to have been but little used as a medicine by the Hindus. The Mahometans have paid more attention to the plant; they consider it to be cold and dry, and that clothes made with the fibre cool the body and lessen perspiration; they recommend fumigation with the smoke for colds in the head and hysteria, and use the tinder to staunch hæmorrhages. Sherriff says if you wish to become thin wear washed linen clothes in the summer but not in winter. The flowers are said to be cardiacal, the seeds aphrodisiacal, and hot and dry. Linseed poultice is recommended for gouty and rheumatic swellings; as an emollient the mucilage is dropped into the eye; with honey it is prescribed in coughs and colds. The roasted seeds are said to be astringent. In Western India, the unripe fruit is used as a vegetable. Flückiger and Hanbury in their *Pharmacographia* (p. 89) give a summary of the history of the plant in the West, and trace its use back to the 23rd century, B. C. It is the λινον of Dioscorides and the Linum of Pliny.* Gallesky (1767) strongly advocated the use of Linseed oil in painter's colic and other spasmodic affections of the bowels. In modern medicine Linseed tea is much used as a demulcent drink in cough depending upon an

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* Dios. ii., 94. Plin. 19; 1. 20; 92.

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irritated and inflamed condition of the pharynx and upper part of the respiratory passages. It is also useful in irritation of the intestinal canal and urinary passages. The meal is one of our best poultice materials. The oil with an equal part of lime water forms the well known application for burns and scalds called Carron oil, and is also given internally as an aperient in piles, dose two ounces, morning and evening. Formerly the oil boiled to the consistence of caoutchouc was used for the manufacture of bougies, catheters, and elastic probes. By interrupting the burning linseed oil by covering the boiler, there remains a brown turpentine-like substance, the so-called *birdlime*. (*Brannt.*)

Description.—The capsule, which is globose, splits into 5 carpels, each containing two seeds separated by a partition. The seeds are of a flattened elongated ovoid form, with an acute edge, and a slightly oblique point blunt at one end. They have a brown glossy polished surface, which under a lens is seen to be marked with extremely fine pits. The hilum occupies a slight hollow in the edge just below the apex. The testa encloses a thin layer of albumen surrounding a pair of large cotyledons having at their pointed extremity a strait embryo. The seeds of different countries vary from $\frac{1}{4}$—$\frac{1}{6}$ of an inch in length, those produced in warm regions being the largest. In India a white variety is sometimes met with. When immersed in water, the seeds become surrounded by a thin, slippery, colourless mucous envelope, which quickly dissolves as a neutral jelly, while the seed slightly swells and loses its polish. (*Pharmacographia*, p 90.)

Chemical composition.—The following summary is extracted from the *Pharmacographia*:—"The constituent of chief importance is the fixed oil which the seed contains to about $\frac{1}{3}$rd of its weight. The proportion obtained by pressure on a large scale is 20—30 per cent. The oil when pressed without heat and when fresh has but little colour, is without unpleasant taste and does not solidify till cooled to —20° C. The commercial oil is dark yellow, and has a sharp repulsive taste and odour. On exposure to the air, especially after having been heated with oxide of lead, it quickly dries up to a transparent varnish, consisting chiefly of linoxyn, $C^{32} H^{54} O^{11}$. The crude oil increases in weight 11—12 per cent., although at the same time its glycerine is destroyed by oxidation.

"By saponification, Linseed oil yields glycerin, and 95 per cent. of fatty acids, consisting chiefly of linoleic acid, $C^{16} H^{26} O^{2}$, accompanied by some oleic, palmitic and myristic acid. The action of the air transforms linoleic acid into the resinoid oxylinoleic acid, $C^{16} H^{26} O^{5}$. Linoleic acid appears to be contained in all drying oils; notably in that of poppy seed. It is not homologous either with ordinary fatty acids, or with the oleic acid of oil of almonds, $C^{18} H^{34} O^{2}$.

"The viscid mucilage of Linseed cannot be filtered till it has been boiled. It contains in the dry state more than 10 per cent. of mineral substances, when freed from which and dried at 110° C., it corresponds, like althæa mucilage, to the formula $C^{12} H^{20} O^{10}$. The seeds by exhaustion with cold or warm water afford of it about 15 per cent. By boiling nitric acid it yields crystals of mucic acid. Its chemical relations are therefore those of gum and not of soluble cellulose. Linseed contains about 4 per cent. of nitrogen, corresponding to about 25 per cent. of protein substances; after expression of the oil, these substances remain in the cake.

"In the ripe state, Linseed is altogether destitute of starch, though this substance is found in the immature seed in the very cells which subsequently yield the mucilage. The water retained by the air-dry seed is about 9 per cent. The mineral constituents of Linseed, chiefly phosphates of potassium, magnesium, and calcium, amount on an average to 3 per cent. and pass into the mucilage. By treating thin slices of the testa and its adhering inner membrane with ferrous sulphate, it is seen that this tegument contains a small quantity of tannin." A. Jorissen has pointed out that a mixture of linseed meal and warm water, when kept at a temperature of 25° C., and then distilled, yields a distillate containing

containing hydrocyanic acid. (*Bull. Acad. Roy. Belg.* (3) V., 750.) The oil is obtained by three methods, cold drawn, by the aid of heat and expression, and by the use of solvents. Seeds 2 to 6 months old are generally used, as the oil from fresh seeds is viscous and turbid. (*Brannt.*) Four qualities of oil are produced, raw, refined, boiled, and artist's oil.

Commerce.—In 1872, India exported to the United Kingdom £1,144,942 worth of Linseed. In 1882 the total exports were valued at more than £3,000,000, and in 1885-86 and 87 the average value of the exports was nearly £5,000,000.

ERYTHROXYLON MONOGYNUM, *Roxb.*

Fig.—*Cor. Pl. i. t.* 88; *Wight Ill. t.* 48.

Hab.—Hilly parts of the Western Peninsula, Ceylon. Red Cedar, Bastard Sandal (*Eng.*).

Vernacular.—Tevadarum, Devadarum (*Tam.*), Adavi-goranti (*Can.*).

E. monogynum is a shrub with pale bark and cuneate obovate leaves, the primary nerves of which are hardly distinguishable from the secondary, which latter are not connected with the intra-marginal nerve. The leaves of this plant are refrigerant, and were largely eaten during the famine in the Madras Presidency, in 1877, by the natives of several districts where it grew wild in abundance, and it was thought probable that they might be found to contain an alkaloid with properties similar to that which is obtained from *E. Coca.* Dr. Cornish just before he left India wrote to ask Mr. Lawson to have the subject investigated, and several consignments of the leaves from the Cuddapah district, were sent to the Government Quinologist for analysis, who found that they contain no anæsthetic principle at all analagous to Cocaine, but a bitter and tonic alkaloid which may have mitigated the pangs of hunger. Squibb's method was used in examining these leaves.

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and by the same method, no difficulty was found in obtaining Cocaine from *E. Coca* grown in India. The wood is fragrant, whence the name Bastard Cedar, and the bark is used as a tonic in the Madura district.

Hugonia Mystax, *Linn., Rheede Hort. Mal. ii., t.* 19; *Wight Ill. i., t.* 32, is a rambling, leafy, tomentose shrub, with yellow flowers, found in the Western Peninsula from the Concan to Travancore, and in Ceylon. According to Rheede, who calls it *Modera canni*, the bruised roots are used to reduce inflammatory tumours and internally as a febrifuge and anthelmintic.

ZYGOPHYLLEÆ.

TRIBULUS TERRESTRIS, *Linn.*

Fig.—*Wight Ic., t.* 98. Small Caltrops (*Eng.*).

Hab.—India and other warm countries. The fruit and root.

Vernacular.—Chota Gokhrú (*Hind.*), Gokhuri (*Beng.*), Lahana Gokhru (*Mar.*), Nerunji (*Tam.*), Negalu-gida (*Can.*), Mitha Gokhru, Beththa Gokhru (*Guz.*). Palleru-mullu, Chiru-palleru (*Tel.*).

History, Uses, &c.—This plant is the Gokshura and Ikshugandha of Sanskrit writers; the first of these names signifies "cow's hoof" from the resemblance of the cocci when adhering together in pairs, as is frequently the case, to a cloven hoof, the second alludes to the aroma of the plant. The Hindus use the fruit and root; they regard them as having cooling, diuretic, tonic and aphrodisiac properties, and use them in gonorrhœa and dysuria. The root is one of the ten drugs which go to form the Dasamula Kvatha, a compound decoction often mentioned in Sanskrit works. The ten plants are *Desmodium gangeticum*, *Uraria lagopodioides*, *Solanum*

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Jacquini, Solanum indicum, Tribulus terrestris, Ægle Marmelos, Calosanthes indica, Gmelina arborea, Stereospermum suaveolens, and *Premna spinosa.* The first five of these are called Hrasva (or laghu) pancha mula, or the five minor plants, and the last five, Vrihat pancha mula, or the five major plants. According to Loureiro, *T. terrestris* is astringent.

It is the Khasak or Hasak of the Arabs and Persians; and is well described by Ainslie, who says:—"It is a common plant near the Dardanelles, and is called in modern Greek τριβόλια. Dioscorides calls it τρίβολος and Pliny tribulus; they both describe two kinds, '*terrestris*' and '*aquaticus.*' The latter is the *Trapa natans, Linn.*, or Water Chestnut.* In the Pharmacopœia of India the use of *T. terrestris* as a diuretic in Southern India is noticed." In Pudukota the flowers rubbed with silver are applied in inflammation of the cornea. The action of this drug on the mucous membrane of the urinary passages appears to resemble closely that of Buchu and Uva Ursi; it may often be advantageously combined with opium and hyoscyamus.

Description.—*Tribulus terrestris* has a slender fibrous root, 4 to 5 inches long, cylindrical, and of a light brown colour; the odour is faintly aromatic and the taste sweetish and astringent. From the root spring four to five delicate stalks, spreading flat on the ground; these are hairy and extend to 2½ feet in length; the leaves are pinnated, leaflets 5 to 6 pairs, nearly round. The flowers are axillary on short peduncles, and composed of five broad obtuse yellow petals; these are succeeded by a roundish five-cornered fruit, about the size of a marble, armed with prickles; this ripening divides into five cells, each armed with 4 strong sharp thorns and containing several seeds. The cocci are wedge-shaped, yellowish when ripe, the external convex surface being rough between the thorns. When all five are *in situ*, the fruit presents ten thorns pointing towards the peduncle, and ten pointing outwards round the circumference; the latter are developed first. This may account for the statement in some books that each coccus has only two spines. The seeds are oily, and enclosed in very hard stony cells. The taste is faintly aromatic and rather agreeable.

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* Dios. iv., 16. Plin. 21, 58; 22, 12. Professor Flückiger has drawn attention to the abundance of manganese in this plant, a fact which has been demonstrated by Gorup-Besanez. *Trapa bicornis* of China and *Trapa bispinosa* of India (Singhára) resemble it in this respect; they are largely used as articles of food in the East, and considered cooling in bilious affections with diarrhœa.

Chemical composition.—An ethereal or an alcoholic extract of the powdered fruits yields to water a crystalline residue containing a body precipitated from its solutions by ammonia and having the properties of an alkaloid, and associated with hydrochloric acid or alkaline chlorides. The fruits also contain a fat and a resin, the latter probably is the source of the aroma of the drug, as it gives off a fragrant odour when burnt. The fruits contain a rather large quantity (14·9 per cent.) of mineral matter.

Commerce—The fruit is collected in the sandy districts of India; it is always obtainable in the drug marts. Value, Rs. 5 per Surat maund of 37½ lbs.

Tribulus Alatus, *Delile. Boiss. Fl. Orient.* I., 902. Winged Caltrops (*Eng.*). *Vernacular.*—Nindotrikund, Latak (*Sind*), Hasak (*Punj.*). The fruits are used for the same purpose as those of *Tribulus terrestris.* The plant is common in Sind, the Punjab, and Beloochistan. Fruit pyramidal, broadly winged; cocci hirsute, two-seeded; spines confluent. (*Murray.*)

FAGONIA ARABICA, *Linn.*

Fig.—*Wight Ill. i., t.* 64.

Hab.—N.-W. India, Sind, Punjab, W. Peninsula, Egypt. The plant.

Vernacular.—Dhamása (*Bomb.*), Ustarkhár (*Hind.*), Dramahui (*Sind.*).

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History, Uses, &c.—This plant is common on grain fields in the Punjab and Deccan; it is suffrutescent, much branched, with opposite two-stipuled leaves; the stipules are often thorny; leaflets linear-cuspidate; the wood of the stem is white and very hard, covered with a ragged, light brown bark, which becomes slimy and mucilaginous when moistened; taste mucilaginous. On account of the prickly nature of the plant it is called in Sanskrit Dusparsha, or "painful to the touch." Dhamása has a great reputation as a suppurative in cases of abscess from thorns, &c.; it is also used for cooling the mouth in stomatitis, the juice being boiled with sugar-candy until quite thick, and a small quantity allowed to dissolve in the mouth frequently; the juice is thought to prevent suppuration when applied to open wounds. Fagonia in Sind and Afghanistan is a popular remedy for fever among the Hill people, and Dr. J. L. Stewart states that *F. Bruguieri, DC.*, is used for the same purpose in the Peshawar valley, and is given to children as a prophylactic against small-pox. It is known by the same vernacular names as *F. arabica*.

GERANIACEÆ.

OXALIS CORNICULATA, *Linn.*

Fig.—*Wight Ic.*, *t.* 18; *Fl. Græc.*, t. 451. Horned Wood-Sorrell (*Eng.*), Oxalide corniculée (*Fr.*).

Hab.—A weed of cultivation, Asia, Europe, &c. The plant.

Vernacular.—Amrulsák, Chuka-tripati (*Hind.*, *Beng.*), Ambutí, Bhuí-sarpatí (*Bomb.*), Puli-yárai (*Tam.*). Puli-chintaku (*Tel.*), Pullam-purachi-sappu (*Can.*).

History, Uses, &c.—This plant, called in Sanskrit works Amlalonika and Chángerí, is considered by the Hindus to be cooling, refrigerant, and stomachic. The fresh juice is given to relieve intoxication from Datura, and is said to be useful in dysentery and prolapsus of the rectum. (*Hindu Materia Medica, Dutt.*) Chakradatta gives the following formula for preparing a ghrita with the herb: *Changeri ghrita*—Take of clarified butter 4 seers, curdled milk (dádhi) 16 seers, leaves of *Oxalis corniculata* beaten into a paste 1 seer. Boil together in the usual way, and prepare a ghrita. The fresh herb made into a poultice with hot water is used as a healing application to various eruptions in the Madras Presidency. In the Concan the plant is rubbed down with water, boiled, and the juice of white onions added: this mixture is applied to the head in bilious headache. Mahometan writers briefly notice the plant as being used by the Hindus. Ainslie describes it, and mentions it use as a cooling medicine in doses of two teaspoonfuls twice a day. The plant is a native of Europe, and is called μοσχοφιλο in modern Greek. In Réunion it is considered a laxative, and is called Petit trèfle.

Description —*O. corniculata* is one of the most troublesome garden weeds in India; the stems are decumbent, rooting; leaves palmately trifoliolate; leaflets obcordate, pubescent; peduncles 2 to 5-flowered; flowers yellow, capsule linear, oblong, many-seeded, densely pubescent; seeds transversely ribbed. All parts of the plant have an acid taste.

Chemical composition.—The different species of Oxalis contain acid potassium oxalate.

Biophytum Sensitivum, *DC. Bot. Reg. xxxi., t.* 68, is a native of Tropical India, Asia, Africa and America.

Vernacular.—Làjri (*Mar.*), Zarir (*Guz.*), Lajàlu (*Hind.*).

This plant is used in incantations. Rumphius sub voce Gallinaria says of it—"Ipse enim Acosta narrat et declarat doctum Bracmanem ipsi spopondisse sub conditione magni certaminis, sese per hanc herbulam effecturum ut mulier, quam desideraret, illum sequeretur, ille autem tam honestus erat ut hasce artes Christianis vetitas, nollet addiscere, nec scriptis suis inserere." Rheede says of it, "the seeds are red and

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shining, and are powdered and applied to wounds, and with butter to abscesses to promote suppuration, the root in decoction is given in gonorrhœa and lithiasis."

Averrhoa Carambola, *Linn.*, and **A. Bilimbi**, *Linn.*, *Rheede, Hort. Mal. iii.*, 43, 44, 45, are cultivated throughout the hotter parts of India, on account of their acid fruits.

Their native country is uncertain, but some suppose them to have been brought from the Moluccas by the Portuguese, who call them Carambola and Bilimbinos. Like some others of the Geraniaceæ, their leaves are sensitive; their fruits are much used by the natives of India as an acid vegetable, and by Europeans as a tart fruit and preserve. They contain much acid potassium oxalate and are used to remove iron moulds. A syrup of the fruit and a conserve of the flowers are used by the natives as a cooling medicine in fever. *A. Carambola* has a yellow angular fruit about the size of a hen's egg; there are two varieties, sweet and sour. *A. Bilimbi* produces a yellowish-green fruit with five rounded lobes about the size of a gherkin, whence the English name Cucumber-tree.

GERANIUM NEPALENSE, *Sweet.*

Fig.—*Wight Ill. i.*, 153, *t.* 59.

Hab.—Temperate Himalaya, Nilgiris, Ceylon.

Vernacular.—Bhánda (*Hind.*).

GERANIUM OCELLATUM, *Camb.*

Fig.—*Royle, Ill.* 149, 150.

Hab.—Sub-tropical Himalaya, Behar, on Parisnath.

Vernacular.—Bhánda (*Hind.*).

GERANIUM WALLICHIANUM, *Sweet.*

Fig.—*Wight Ic. t.* 324.

Hab.—Temperate Himalaya, Kuram Valley, Afghanistan.

Vernacular.—Mámirán (*Afghan.*).

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A plant called γερανιον is mentioned by Dioscorides (iii. 122,) having a fruit like the the head of a crane (γερανος); it appears to have been used as an astringent in certain affections of the vagina. Pliny (26, 68) mentions three kinds of this plant which have been identified with *Erodium moschatum, Aiton, Geranium molle, Linn.*, and *Geranium tuberosum, Linn.*

Geranium Robertianum, Linn., Herb Robert (*Eng.*), Bec de grue, Robertin (*Fr.*), a native of Europe and of the West temperate Himalaya, was formerly used in Europe as a vulnerary in hæmorrhages, and as an application to tumours and ulcers; internally it was given in gravel, jaundice and ague. It has a strong odour and a bitter, saline and astringent taste. In America *Geranium maculatum, Linn.*, a native of Canada and the United States, is official, and the root is known as *Alum root*; it contains tannic and gallic acids (*Tilden*), to which it owes its medicinal properties.. (*Fig.—Bentl. and Trim.* 42.)

The Indian Geraniums used medicinally, the names of which are placed at the head of this article, have the astringent properties common to the genus. The root of *G. nepalense* affords abundance of red colouring matter, and is used for colouring medicinal oils like alkanet (Ratanjot).

Aitchison in his article upon the Kuram Valley Flora observes that the root of *G. Wallichianum* is called Mámirán by the Afghans, and is used as an astringent application to the eyes, (*Journ. Linn. Soc.*, xviii., p. 26.)

The Arabs call the wild Geraniums Ibrat-ur-raai or Shepherd's needle.

RUTACEÆ.

RUTA GRAVEOLENS, *Linn.*, var. *angustifolia.*

Fig.—*Bot. Mag.* 2311. Garden Rue (*Eng.*), Rue des jardins (*Fr.*).

Hab.—Cultivated in the East. The herb.

Vernacular.—Sudáb (*Hind., Mar., Guz.*), Arvada (*Tam.*), Sadápa, Arudu (*Tel.*), Nágadali-sappu (*Can.*).

History, Uses, &c.—Rue was held in high estimation by the Greeks and Romans. Aristotle in his *History of Animals* (ix. 6) tells us that the weasel before fighting with serpents, rubs itself against this plant. Hippocrates considered it to be resolvent and diuretic, and notices it in his chapter on female diseases. Pliny notices it in several parts of his Natural History, and calls it one of the best medicinal herbs. Celsus says of Rue, "Urinam movet, sensus excitat, purgat, mollit." Apuleius (*De Ver. Herb.*) recommends the following superstitious practise "ad profluvium mulieris"; "Herbam rutam circumscribe auro et argento et ebore, et sublatam eam alligabis infra talum." Macer Floridus states that Mithridates, king of Pontus, used rue as a protection against poison:—

> "Obstat pota mero vel cruda comesta venenis.
> Hoc Metridates rex Ponti sæpe probavit,
> Qui Rutæ foliis, &c."

Johnston, in his *Thaumatographia Naturalis*, writes:—"Ruta libidinem in viris extinguit, auget in feminis." The plant was hung round the neck in the Middle Ages as a charm against vertigo and epilepsy; it was considered emblematic of good luck, and a protection against sorcery, a herb dear to women, &c. (*De Gubernatis.*)

The Hindus received the plant from the West along with the superstitions connected with it; they burn the leaves for the purpose of fumigating young children suffering from catarrh, and use a tincture of them as an external remedy in paralytic affections, and administer them internally in dyspepsia. They consider rue injurious to pregnant women, an opinion expressed by Dioscorides.

The Arabians class rue among their attenuentia, vesicatoria and stimulantia. The author of the Makhzan-el-Adwiya describes three kinds—garden, wild, and mountain rue. He considers it to be hot and dry in the third degree; to increase the mental powers, to act as a tonic and digestive, and to increase the urinary and menstrual excretions. He also states that it acts as an antaphrodisiac and causes abortion

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when given to pregnant women. The diseases in which it is recommended are so numerous that we must refer the reader to his article "Sudáb." The old European physicians considered rue to be antispasmodic, stimulant and emmenagogue, and prescribed it in hysteria and flatulent colic. Boerhaave extols its virtues in promoting perspiration.

Rue is the *Herb Grace* of old English writers, and is still much used as a domestic remedy. Alibert says of it, "Cette plante a un grande action sur le système nerveux, et particulièrement sur le système uterin. Beaucoup de femmes en prennent dans les menstrues laborieuses." The dose of the powdered leaves is from ten grains to a scruple or more, twice or thrice daily. Rue occupies a corner in most Indian gardens. It is largely grown near Grasse in France, 150 to 200 lbs. produce 1 lb. of oil.

Rue is an active irritant, whether applied externally or taken internally. It has been frequently used with success to procure abortion; sometimes it produces painful vomiting, always great prostration, confusion of mind, cloudy vision, feebleness and slowness of pulse, coldness of the extremities, and twitching of the limbs; in pregnant women the drug produces pain in the back, bearing down, and frequent micturition, followed by pains and abortion about ten days after the commencement of its administration. Oil of Rue has been observed to produce similar symptoms with increased frequency and diminished tension of the pulse; on the other hand, when an infusion of the dry leaves was used, the pulse fell from 80 to 69 in three hours.—(*Van de Warker, Criminal Abortion,* 1872.)

Description.—The variety angustifolia is thus described in the *Flora of British India*:—"Leaves petioled, triangular ovate, decompound, segments various, corymbs spreading, bracts lanceolate, sepals triangular acute, petals ciliate, capsule obtuse, shortly pedicelled.

Chemical composition.—The essential oil, when purified by a few rectifications, is somewhat viscid; has a specific gravity of

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0·837 at 18°; a strong disagreeable odour, like that of the plant; a slightly bitter aromatic taste; boils at 228°—230°, and solidifies between + 1° and 2°, to shining crystalline laminæ, resembling those obtained from Anise oil. The chief volatile constituents of rue are methyl-nonylketone, and a hydrocarbon. The ketone, separable by alkaline bisulphites, was formerly regarded according to the investigations of Gerhardt and of Cahours, as capric or rutic aldehyde, $C^{10} H^{20} O$. But Greville Williams has shown that the crude oil contains two such compounds, *viz.*, $C^{11} H^{22} O$ and $C^{12} H^{24} O$, the latter in comparatively small quantity; and this result has been confirmed by Harbordt. The portion of rue oil, which does not combine with alkaline bisulphites, is separable into a more volatile portion, having the composition of Turpentine oil, and a less volatile portion, which appears to be isomeric with Borneol, but boils at a lower temperature. For a fuller account of the chemistry of Rue, see *Watt's Dict. of Chem.*, Vol. V., p. 132.

Commerce.—Rue is cultivated in India for medicinal use. It is also imported from Persia. Value, Re. ¼ per lb.

PEGANUM* HARMALA, *Linn.*

Fig.—*Lam. Ill.*, 401. Syrian Rue (*Eng.*), Rue Sauvage (*Fr.*).

Hab.—N.-W. India, Western Deccan. The seeds.

Vernacular.—Hurmal, Hurmaro, Ispand (*Hind.*, *Bomb.*, *Beng.*), Shimai-azha-vanai-virai (*Tam.*), Shima-goranti-vittulu (*Tel.*).

History, Uses, &c.—In native works on Materia Medica, Hurmal is described as an alterative and purifying medicine in atrabilis, and also in diseases supposed to arise from cold humours, such as palsy, lumbago, &c.; it is also said to stimulate the sexual system both in the male and female, increasing the flow of milk and menses in the latter. For administration a concentrated decoction is mixed with sweet oil and honey, or the crushed seeds are boiled in wine down to one-fourth of the original bulk of the latter, and the mixture strained (*vide* Makhzan-el-Adwiya, article Hurmal). Dr. P. Gopal, who has experimented with this drug, informs us that the infusion or tincture acts as a stimulant emmenagogue, and produces slight intoxication like *Cannabis indica.* He gave the tincture in ½ drachm doses to a female suffering from amenorrhœa, and it had the effect of producing a free menstrual discharge; he further says that it is sometimes used by the native midwives to procure abortion. Dr. Gopal believes that it has properties in common with Ergot, Savine, and Rue. The equal activity of watery and spirituous preparations may be explained by the fact that the red resinous colouring matter is a secondary product formed by the oxidation of the alkaloid Harmaline; it is only produced after digestion of the seeds in spirit. In Persia *P. Harmala* is called Sipand; when sprinkled upon burning coals it is supposed to avert the malignant influence of the evil eye. Popular allusions to it in Persian books are frequently met with.

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* *πήγανον.* The Greeks and Romans speak of two kinds of Peganon or Rue, '*garden*' and '*wild*, or, *mountain Rue*,' and Apuleius Platonicus gives *armala* as the Syrian name of *Ruta hortensis*, or Garden Rue. He mentions Peganon agrion separately, and says the Italians call it *Ruta montana*.

Description.—The drug, as found in the bazaar, consists of the seeds mixed with a few pedicels surmounted by the five-partite calyx and portions of the three-celled, three-furrowed capsule. The seeds are of a dull greyish brown colour, irregularly angular, and about ⅛ of an inch long; they have a heavy narcotic odour when crushed, and a bitter taste.

Microscopic structure—The testa, which is rough and squamous, may be seen to consist of two rows of large honeycombed cells, the walls of which contain brown colouring matter. The kernel is greenish, and when a section is placed in glycerine for examination, it immediately developes a fine green fluorescence; it consists of two longish cotyledons surrounded by albumen; the cell contents of both appear granular.

Chemical composition.—Some seeds crushed, and treated with water for a few minutes, produced after filtering a pale yellow fluid with a marked green fluorescence; this was destroyed by alkalies and restored by acids. A further examination of the seeds was made by exhausting them with rectified benzine, rectified spirit, and water acidulated with hydrochloric acid. The benzine solution was of a pale yellow colour, and upon evaporation yielded a rich reddish brown oil, having no very marked odour and a nauseous taste. The tincture made with rectified spirit was of a deep red, like Tra. Lavandulæ Comp., very opaque and highly fluorescent. Upon evaporation it yielded a soft extract of the colour of Dragon's blood, and having the odour of *Cannabis indica.* This, when exhausted with water, gave a pale red solution with a green fluorescence, which, when treated with a solution of oxalate of ammonia, threw down the red colouring matter and became pale yellow. but retained its fluorescence. The remainder of the spirituous extract, after complete exhaustion with water, consisted of a soft resin of a deep carmine lake colour, having a heavy narcotic odour like resin of *Cannabis indica.* The portion treated with acidulated water yielded a pale sherry-coloured fluorescent solution, which, upon evaporation, gave a soft yellow extract, with an odour like honey; the greater part of this dissolved in rectified spirit, forming a yellow fluorescent solution; this, after filtration, was evaporated to a thin syrup, and upon cooling formed a dark brown mass. The seeds contain two alkaloids, *Harmaline*, $C^{13} H^{14} N^{2} O$, discovered by Gobel in 1837, and *Harmine*, $C^{13} H^{12} N^{2} O$, discovered by Fritszche in 1847. The yield of the two alkaloids according to Fritszche is 4 per cent., of which one-third is Harmine and two-thirds Harmaline. These two substances have been recently examined by O. [illegible]cher and E. Tacaber (*Ber. d. Chem. Gesselsch.*, 1885, 400, 406). Harmaline crystallises from its solution in methylic alcohol in yellowish scales little soluble in water or ether,

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soluble in cold alcohol, and very soluble in boiling alcohol; it colours the saliva yellow. It melts at 238° C., and is decomposed; heated with strong sulphuric acid it forms Harmaline-sulphuric acid, which on the addition of water, gives a fine blue fluorescence. Treated under pressure with fuming hydrochloric acid it yields *Hermatol,* which forms orange-red crystals sparingly soluble in water. This solution is strongly fluorescent and is probably identical with the yellow colouring matter of the seeds. Harmaline forms with acids crystallizable yellow salts soluble in water, to which they communicate a remarkable fluorescence. Harmine which exists in the seeds, is also obtained by oxidizing Harmaline with nitric acid. It crystallizes in colourless needles almost insoluble in water and very little soluble in cold alcohol or ether; it fuses at 256° C., and is partly sublimed and partly decomposed. Fuming hydrochloric acid converts it into *Harmal,* the acid solution of which is fluorescent. Oxidised by means of chromic acid it yields Herminic acid, $C^{10} H^{8} N^{2} O^{4}$, which crystallizes in silky tufts.

Commerce.—Hurmal seed is imported from Persia, but the plant has been introduced into India by the Mahometans, and in some places has run wild. In Southern India Henna seeds under the name of *Iswand* are used as a substitute for this drug. Value, Rs. 2½ per Surat maund of 37½ lbs.

ZANTHOXYLUM RHETSA, *DC.*

Fig.—*Rheede, Hort. Mal.* v., t. 34. Indian prickly Ash (*Eng.*), Clavalier d'Inde (*Fr.*).

Hab.—Western Peninsula.

Z. ALATUM, *Roxb.*

Hab.—Sub-tropical Himalaya.

Z. ACANTHOPODIUM, *DC.*

Hab.—Sub-tropical Himalaya.

Z. OXYPHYLLUM, *Edgw.*

Hab.—Temperate and sub-tropical Himalaya.

Z. HAMILTONIANUM, *Wall.*

Hab.—Assam and Burma.

Z. BUDRUNGA, *Wall.*

Hab.—Tropical Himalaya.

The carpels.

Vernacular.—Z. Rhetsa, Rhetsa-maram (*Tam.*), Rhetsa-maum (*Tel.*), Jimmi-mara (*Can.*), Tisal, Triphal, Chirphal (*Mar.*). *Z. alatum* and *Z. acanthopodium,* Tambul (*Beng.*), Nipáli-dhanya, Tumra, Tejphal, Darmar (*Hind.*). *Z. Budrunga,* Badrang (*Hind.*).

History, Uses, &c.—Sanskrit writers call the carpels of *Z. alatum* and *Z. acanthopodium* by the name of Tumburu, which signifies "coriander"; the fruits of these trees are so similar in appearance that they can hardly be distinguished. They have the peculiar flavour of coriander, and are about the same size as that fruit. In Hindu medicine they are considered to be hot and dry. The Chinese also use the carpels under the name of Hwa-tseaou or "Pepper flower," and in Japan the carpels of *Z. piperitum* are used. The Arabians appear to have obtained the carpels of *Z. alatum* or *acanthopodium* first from Northern India. Ibn Sina under the name of Fághireh (open-mouthed) describes them as "a berry the size of a chick pea containing a black seed as large as a hemp seed, brought from Sakála in Hindustan." Sakala or Sangala was an ancient town in the Punjab, near the modern Sanglawala Tiba or Sangla Hill. It is the Sangala of Alexander, and was visited by the Chinese pilgrim Hwen Thsang in A. D. 630; it had then a large Buddhist monastery and a stupe 200 feet high. Háji Zein el Attár, who wrote A.D. 1368, gives a similar account of Fághireh, and says that the

Persians call it Kabábeh-i-kusháleh (open-mouthed cubebs). The fruits of a *Zanthoxylum* are figured by Clusius under the name of Fagara Avicennæ in his *Arom. Hist.*, Ed. 1605, p. 185, but they are probably those of *Z. Rhetsa*. The true Fagara Avicennæ is the Fagara minor of the old Pharmacologists. Later Mahometan writers speak of a Fághireh coming from South India, and doubtless allude to the carpels of *Z. Rhetsa*, a large tree of the Western Peninsula which derives its botanical name from the Telugu word Rhetsa, "an assembly." Roxburgh tells us that the elders amongst the Telugu people meet under this tree to settle disputes, it is therefore called Rhetsa-maum or "assembly tree." *Z. Budrunga*, a tree of the tropical Himalaya, has carpels which can hardly be distinguished from those of *Z. Rhetsa*. The Mahometan physicians consider Fághireh to be hot and dry, and to have astringent, stimulant, and digestive properties. They prescribe it in dyspepsia arising from atrabilis, and in some forms of diarrhœa. The inhabitants of Southern and Western India use the carpels of *Z. Rhetsa* as a condiment, especially with fish; as a medicine they are given in honey for rheumatism, and the essential oil as a remedy for cholera. These carpels are the Fagara major of the old pharmacologists, and are much larger than those described by Ibn Sina. The fruits of *Z. oxyphyllum* and *Z. Hamiltonianum* are also used: they are so similar to one another in appearance as to be hardly distinguishable. Besides its medicinal uses, Fagara minor is used as an ingredient in *Guráku* (tobacco for the *hukka*), and in the preparation of ground bait for fishing. The bark of these trees is tonic and aromatic, and may be used with advantage in rheumatism and in atonic dyspepsia; the root bark is to be preferred. Heckel and Schlagdenhauffen (*Académie des Sciences*, *Ap. 21st*, 1884,) reported that a crystalline principle, obtained from the bark of a West Indian *Zanthoxylum*, produced in frogs, rabbits, &c., general paralysis and abolition of the functions of respiration and circulation. (*See Berberine*, *p.* 66.)

Description.—The fruits of *Z. alatum* and *Z. acanthopodium* consist of the carpels usually dehiscing and empty, but sometimes enclosing the round, black, shining seed. In perfect specimens we find a slender pedicel supporting the carpels, which are nominally four in number, but of which at least one or two are mostly abortive. The carpels are oval or nearly spherical, $\frac{2}{10}$ths of an inch in longest dimension; externally they are of a bright reddish-brown, covered with prominent tubercles filled with oleo-resin; internally they are furnished with a hard, papery, white membrane, which becomes loose, contracts and curls up when the seed falls. The drug has an aromatic taste (at first like coriander) and an agreeable aromatic odour. The fruits of *Z. Rhetsa* and Budrunga are of the same shape, but as large as a pea, and the external surface of the carpel does not show the prominent tubercles above mentioned, but is finely wrinkled, of a reddish-brown colour, and not lined with a hard white papery membrane. The taste is at first like that of lemon peel, but afterwards extremely pungent like that of *Z. alatum*, producing much the effect of Pyrethrum upon the palate. The fruits of *Z. oxyphyllum* and *Z. Hamiltonianum* are of the same size as those of *Z. alatum*, but sessile and without prominent tubercles; they are of reddish-brown colour, and have a fine wrinkled surface like *Z. Rhetsa*: a hard, white papery membrane is present which becomes loose and contracts when the seed falls. In taste they resemble *Z. Rhetsa*. The shining black seeds of all these species have a feeble peppery taste. Sections of the capsules when magnified show that their elasticity is due to the presence of strong bands of spiral fibres. The dry open capsules when soaked in water resume the shape that they had before dehiscence.

The root bark of *Z. Rhetsa* is of a reddish-brown colour, and is covered with a light yellow suber, which easily separates in papery flakes; it has an agreeable aromatic odour and a bitter taste.

Chemical composition.—The bitter crystalline principle present in the bark of the Zanthoxyleæ, and formerly called *Zanthopicrite*, has been recognised as identical with berberine

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by Dyson Perrins. (*Trans. Chem. Soc.*, 1862.) The bark also contains a volatile oil and resins. Dr. Stenhouse has obtained from the carpels of *Z. alatum* by distillation an essential oil to which the aromatic properties are chiefly due. This oil, which when pure is called by Dr. Stenhouse *Zanthoxylene*, is a hydrocarbon isomeric with oil of turpentine. It is colourless, refracts light strongly, and has an agreeable aromatic odour; similar to that of Eucalyptus oil; its composition is $C^{10} H^{8}$. He also obtained a stearopten, *Zanthoxylin*, floating on the water distilled from the carpels and separable from the crude essential oil. After repeated crystallizations from alcohol, zanthoxylin may be obtained in a state of purity, and then presents the form of large crystals of a fine silky lustre, insoluble in water, but readily soluble in alcohol or ether. It has a very slight odour of stearine, and a slightly aromatic taste. It distils unchanged, its fusing point before and after distillation remaining the same, namely, 80° C., and its solidifying point 78° C. Its composition is $C^{40} H^{6} O^{4}$. The essential oil was obtained by Pedler and Warden (1888) by distilling the crushed carpels with seeds, in a current of steam. The oil was dehydrated by fused $Ca\,Cl^{2}$. It commenced to boil at 175°—176° C., the greater part passing over between 176°—179° C., the temperature then rose to 181° C. and rapidly to 183° C., when the distillation was stopped. The rectified oil had a specific gravity of ·873 at 15·5 C. Its vapour density determined by Meyer's method was 5·43. They were unable to obtain the crystallizable stearopten isolated by Stenhouse. The freshly distilled oil exposed to 0° C. failed to deposit any crystals. In addition to the essential oil, they also detected the presence of a pale yellow viscid non-drying oil, an acid resin, and a yellow acid principle, forming deep yellow solutions with alkalies and reprecipitated from its alkaline solution by acids.

Several species of Evodia bear capsules very similar to those of Zanthoxylum, notably *E. fraxinifolia*. An oil, supposed to have been yielded by these capsules, was recommended by Helbing (*British Pharm. Confer.*, 1887,) as a deodorant for iodoform; but the fruit of *E. fraxinifolia* does not agree with

Helbing's description, nor does it yield an oil of the nature described by him. The seeds of *E. fraxinifolia* are brown.

TODDALIA ACULEATA, *Pers.*

Fig.—*Rheede, Hort. Mal.* v., 41; *Wight Ill. t.* 66; *Lam. Ill.* ii., 116; *Bentl. and Trim, t.* 49. Espinho do ladrâo (*Port.*), Patte de poule (*Fr.*).

Hab.—Sub-tropical Himalaya, Western Peninsula, Ceylon. The root and fruit.

Vernacular.—Milakaranai (*Tam.*), Konda-kashinda (*Tel.*), Kúdúmiris-wel (*Cing.*), Kánch, Dahan (*Hind.*), Limri (*Mar.*), Kaka-toddali (*Mal.*).

History, Uses, &c.—This scandent shrub appears to have been one of the plants known to Sanskrit writers as Kánchana or golden, on account of the orange colour of its fruit. It was also called Dahana or burning, on account of the pungency of its berries; both of these names are still in use in the vernacular. Rheede says that the unripe fruit and root are rubbed down in oil to make a liniment for rheumatism. Ainslie mentions its use in Southern India. He says:—"Malakarunnay (*Scopolia aculeata, Smith,*) is the Tamool name of a small white root about the third part of an inch in diameter, the bark of which is bitter, pungent and sub-aromatic, and is considered as stomachic and tonic. It is given in a weak infusion to the quantity of half a teacupful in the course of the day; the leaves are also sometimes used for the same purpose." Roxburgh, in the *Flora Indica*, describes the plant fully, and says: "That every part of this shrub has a strong pungent taste; the roots, when fresh cut, particularly so. The fresh leaves are eaten raw for pains in the bowels; the ripe (unripe) berries are fully as pungent as black pepper, and with nearly the same kind of pungency; from these the natives prepare an excellent pickle." The fresh bark is administered by the Telinga physicians for the cure of that sort of remittent commonly called "hill fever." Flückiger and Hanbury have the following account of the history of Toddaliæ Radix:—"It is from this and other species of Toddalia, or from the allied genus Zanthoxylum, that a drug is derived, which, under the name of Lopez root, had once some celebrity in Europe. This drug was first made known by the Italian physician Redi, who described it in 1671 from specimens obtained by Juan Lopez Pigneiro at the mouth of the river Zambesi, in Eastern Africa, the very locality in which, in our times, *Toddalia lanceolata, Lam.*, has been collected by Dr. Kirk. It was actually introduced into European medicine by Gaubius in 1771 as a remedy for diarrhœa, and acquired so much reputation that it was admitted to the Edinburgh Pharmacopœia of 1792. The root appears to have been sometimes imported from Goa, but its place of growth and botanical origin were entirely unknown, and it was always extremely rare and costly. It has long been obsolete in all countries except Holland, where, until recently, it was to be met with in the shops." In the Pharmacopœia of India it is stated that Toddaliæ Radix is probably a remedy of great value in constitutional debility, and in convalescence after febrile and other exhausting diseases. It is very strongly recommended by Dr. Bidie, of Madras. The French in India use it under the name of *Bois de ronce*.

Description.—The root is woody and in cylindrical flexuose pieces, from ½ to 2 inches in diameter. The bark is about $\frac{1}{12}$th of an inch thick, and consists of a soft, yellow, corky external layer, wrinkled longitudinally, a thin bright yellow layer, and a firm brown middle cortical layer and liber. The wood is hard, yellow, and without taste or smell: its pores are arranged in a concentric manner, and the medullary rays are numerous and narrow. The flowers are white, scented, in simple or compound racemes, and are succeeded by 3 to 5-celled orange-coloured berries as large as a pea, and having a hot peppery taste when unripe. The dry berries are dark brown or nearly black, and have a pungent, aromatic, and very agreeable flavour like citron. When magnified the bark shows a number of large cells filled with oleo-resin. Some cells contain raphides. The vascular system is loaded with oleo-resin.

Chemical composition.—The bark contains a resin, and an essential oil in flavour recalling oil of citron, also a bitter principle. In the aqueous infusion, tannic acid produces an abundant precipitate of the bitter principle, which probably is of an indifferent nature. Flückiger and Hanbury were unable to detect berberine in the bark. On distillation the leaves yield a pale yellowish green limpid oil, having the odour of citron peel, and a bitter and aromatic taste. The specific gravity at 17° C. is ·873; examined by polarized light in a tube of 200 m. m. it rotates 15°·30′ to the left. The oil has no constant boiling point, but the greater part distils over between 190° and 210°. Metallic sodium has a slight action upon it which causes a yellow colour, and a white deposit in the oil. Sulphuric acid instantly changes it to a rich brown, and nitric acid strikes a transient pink. The oil readily dissolves iodine, and its solution in alcohol is not affected by ferric salts. It absorbs dry hydrochloric acid with considerable rise of temperature and deepening of colour, but no crystals were observed in the mixture after reposing a few days with an excess of the gas.

MURRAYA KŒNIGII, *Spreng.*

Fig.—*Wight Ic., t.* 13; *Roxb. Cor. Pl. II., t.* 112. Curry leaf tree (*Eng.*).

Hab.—Himalaya, Bengal, Western Peninsula, Ceylon.

Vernacular.—Karhi-nimb, Jhirang, Jirani (*Mar.*), Gora-nimb (*Guz.*), Ganda-nim (*Panj.*), Katnim (*Hind.*), Karibevu (*Can.*), Karu-veppilai (*Tam.*), Kari-vepachettu (*Tel.*), Barsunga (*Beng.*).

History, Uses, &c.—This small tree, in Sanskrit Saurabhi-nimba, or fragrant Neem, is found wild in

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mountainous districts, and is also much cultivated for the sake of the leaves, which are much used as a condiment. The bark and root have stimulant properties, and are applied externally to parts bitten by venomous animals; the leaves are given raw in dysentery, and are also applied externally to cure eruptions. (*Roxb.*) An infusion of the toasted leaves, according to Ainslie, is used by the Hindus to stop vomiting. The plant is noticed in the Pharmacopœia of India as having tonic and stomachic properties. The leaves are much used as an ingredient in sauces and are sometimes given in decoction with bitters as a febrifuge. Judging by the Marathi names, it must be one of the plants used as condiments and described by Sanskrit writers under the name of Jarana or Jirana.

Description.—The leaves are pinnate with numerous leaflets which are 1¼ inch to 2 inches long, alternate, unequally oblique at the base, irregularly ovate, serrated, pubescent, upper surface dark green, dotted, under surface of a lighter colour, venation reticulated, petioles reddish, odour powerful, taste moderately pungent, bitter, and acidulous. The roots spread widely and send up numerous suckers; they have a thick soft bark, the parenchyme of which is loaded with oil globules. It has an agreeable odour and taste like fresh ginger.

The leaves yield to distillation a small quantity of volatile oil resembling that obtained from the leaves of *Ægle Marmelos*.

Chemical composition.—As a considerable quantity, 28 pounds, of the leaves had been previously distilled with water and yielded only a few drops of oil, it was not thought necessary to extract with petroleum ether. A weighed quantity, 80 grams, of the sun-dried and powdered leaves was exhausted with ether, and a measured quantity evaporated, dried and weighed, yielded a greenish-black resin equivalent to 7½ per cent. of the leaves. The bulk of the ethereal extract was allowed to evaporate by exposure to the air, and the residue was instantly mixed with freshly ignited pumice, and extracted

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with water. A measured quantity, evaporated, dried and weighed, yielded a small residue equivalent to 3 per cent. of the resin. The aqueous extract was slightly acid to litmus, precipitated by acetate of lead, darkened by iron salts, but not precipitated by gelatine. It reduced Fehling's solution.

The residue from the aqueous extract was dried and exhausted with alcohol, in which it was completely soluble. This alcohol extract allowed to evaporate, yielded a greenish-black resin, of bitter taste, and peculiar odour. It was freely soluble in chloroform, bisulphide of carbon, benzol and amylic alcohol, less soluble in glacial acetic acid and petroleum ether, and almost insoluble in acetic ether. These solutions allowed to evaporate failed to produce anything crystalline, but left the unaltered resin. Treated with sulphuric acid the resin gives an emerald green coloration. It is readily oxidized and attacked by nitric acid, dense red fumes being evolved with considerable frothing, forming a deep red solution, which gives a yellow precipitate on pouring into water, soluble in a larger portion of hot water with yellow solution. The remainder of the acid solution evaporated to dryness, and the yellow residue neutralized with solution of caustic potash, gives a deep red liquid, which is precipitated by sulphate of copper and coloured a deeper red by cyanide of potash. It stained the skin, and dyed silk and flax a yellow colour, the yellow colour of the silk being permanent on washing in water. On heating a portion of the yellow acid residue in a crucible covered with a watch glass, a yellow crystalline sublimate was obtained. These reactions prove the presence of picric acid.

The resin was unaffected by boiling aqueous potash, but dissolved in alcoholic potash. After digesting a day, the potash solution was shaken up with ether; between the ethereal and aqueous solution a layer of fine crystals was observed, but in too small quantity for examination. The ethereal solution evaporated yielded some resin apparently unaltered. A portion of the potash solution poured into water separated some resin as a greenish-yellow powder. Another portion treated with

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excess of acid separated the resin apparently unchanged. The dried residue of the ethereal extract was exhausted with absolute alcohol and a measured quantity evaporated, dried and weighed, yielded a residue equivalent to 2½ per cent. of the leaves. The alcoholic extract was completely soluble in water, and gave similar reactions to the aqueous extract of the resin. It was slightly acid to litmus, and of a bitter taste. On acidifying with sulphuric acid and shaking with solvents, chloroform removed a slight residue of a greenish-black colour and uncrystalline. On concentrating the acid solution and setting aside, a few granular crystals separated; these were washed with a little alcohol and recrystallized, forming tufts of acicular crystals. They gave a yellow coloration with caustic potash, but were not coloured by either cold or warm sulphuric acid. They were sparingly soluble in water and alcohol. The aqueous solution was precipitated by tannin and acetate of lead. It slightly reduced Fehling's solution and gave an orange precipitate with a ferroso-ferric salt. It was not precipitated by Mayer's re-agent, nor by bi-iodide of potash. Ferric chloride produced no coloration or precipitate. The mother liquor from the above crystals was allowed to evaporate, and dried up to a bitter black extract. The crystalline principle is probably a glucoside, and might be provisionally named Kœnigin. (*J. G. Prebble.*)

Murraya exotica, *Linn., Wight Ic. t.* 96. China Box, Honey bush (*Eng.*), Buis de Chine (*Fr.*). *Vern.*—Bibsar (*Hind.*), Kámini (*Beng.*), Kounti (*Mar.*), Naga-golugu (*Tel.*), Murchob (*Kumaon*), is a favourite evergreen shrub in gardens, which bears large bunches of sweet-smelling flowers like orange blossom. It has pinnate leaves with coriaceous leaflets, much resembling box leaves in shape, taste and odour. De Vrij has separated a glucoside from the flowers, which he has named *Murrayin*; its composition is $C^{18} H^{22} O^{10}$.

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ATALANTIA MONOPHYLLA, *Corr.*

Fig.—*Wight Ic., t.* 1611; *Rheede, Hort. Mal. iv., t.* 12 Wild Lime (*Eng.*)

Hab.—Sylhet, Western Peninsula, Ceylon.

Vernacular.—Matangnár, Mákar-limbu (*Mar.*), Kat-ilimicham (*Tam.*), Adivi-nima (*Tel.*), Katunimbe-gida (*Can.*).

History, Uses, &c.—Rheede says that an oil of the leaves is cephalic, the root antispasmodic, and the juice of the fruit anti-bilious. According to Loureiro, the root is heating, resolvent and stimulant.

Ainslie tells us that a warm, pleasant smelling oil is prepared from the berry of this plant, which in Southern India is considered a valuable external remedy in chronic rheumatism and paralysis. In the Concan the leaf-juice is an ingredient in a compound liniment used in hemiplegia. (*Vanaushadi Prakasha*, 1, 404.)

Description.—*A. monophylla* is a large, thorny, climbing shrub, common on the hills of the W. Peninsula and in Sylhet; the leaves are fragrant like those of the orange; the berry is globular, yellow, about 1 inch in diameter and divided into four cells by membranous septa, one cell is generally abortive; pulp like that of a lime but very scanty; each cell contains one seed $\frac{3}{4}$ of an inch long and $\frac{1}{2}$ an inch broad, having one convex and two flat surfaces like the segment of an orange; the rind of the fruit has a faint odour of orange peel and abundant oil cells. The oil prepared by the natives is obtained by powdering the seeds, which are very aromatic when fresh, sprinkling them with sweet oil and expressing; the result is a dark green, pleasant smelling oil, which communicates an agreeable warmth to the skin when rubbed on it. The seeds pressed by themselves yield no fatty oil, but the press cloths are moistened with essential oil. A similar preparation is made from the seeds of *Limonia alata, W. & A.*, in the Nilgiris, and a decoction of the leaves of the same plant is applied to cure itch; its Tamil name is Kuruntha.

LIMONIA ACIDISSIMA, *Linn.*

Fig.—*Rheede, Hort. Mal. iv., t.* 14; *Roxb. Cor. Pl., t.* 86.

Hab.—Himalaya, Behar, Assam, W. Peninsula. The fruit.

Varnacular.—Beli (*Hind.*), Tor-elaga (*Tel.*), Nai-bél (*Mar., Can.*).

History, Uses, &c.—Rheede calls it 'Tsjerou-katou-naregam,' and gives 'Limonis da folha cruzado' as the Portuguese name. Regarding its medical properties he says: "Cæterum arboris hujus folia præsentaneum habentur curandæ epilepsiæ remedium. Radix alvum movet, sudores expellit, nec non cruciatibus colicis et cardialgiæ medetur. Fructus siccati stomachum roborant, ac alimentorum in eo fermentationem læsam restituunt; adhæc acri ex variolis, febribusque malignis et pestilentialibus contagiosa potenter resistunt, atque variis venenis præstantissimum censentur antidotum; quamobrem magni æstimantur, et ab Arabibus aliisve mercatoribus avide expetuntur." Graham, Drury and others copy from Rheede, but Drury adds that the fruit is used in Java instead of soap. (*Cf. Rumphius.*) This use of the fruit is known in India, and is indicated by the Marathi name which signifies "barber's Bael fruit."

Description.—*A. acidissima* is a shrub with tripinnate leaves and winged petioles; the root is yellow, bitter and aromatic; the fruit globular, the size of a grape, with yellowish-red rind like that of the lime in structure, and a scanty very acid flesh-coloured pulp with some bitterness and aroma; it is four-celled, but usually contains only three seeds of the colour of orange pips. The fruit is eaten as a stomachic by the hill tribes, but is not seen in the Bombay market. The cultivated *sour lime* in a dried state is often offered in large quantities. It is exported to the Arabian coasts, where it is used as a condiment with fish, meat, &c., being powdered along with the spices commonly used in cooking.

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Paramignya monophylla, *Wight, Ill. i., t.* 42, a scandent shrub of the Sikkim Himalaya, Bhutan, Tenasserim, W. Peninsula, and Ceylon, has a reputation as an alterative and diuretic. The root, which is the part used, has a scabrous brown bark and a bitter saline taste; it abounds in large crystals of oxalate of lime. From the resemblance of the fruits to those of *Capparis zeylanica,* the Marathas call it Karuwageti (bitter Wageti). In the Concan the root is given to cattle suffering from bloody urine.

Kakkola.—This is the Sanskrit name of a rutaceous berry, apparently that of **Luvunga scandens,** *Ham.* The berries, as sold in the shops, have a glandular papillose exterior, and a terebinthinate odour and taste; they vary much in size, and contain from one to four dark green, oily seeds with a membranous testa, of the size and shape of orange pips. The berries are used in preparing a perfumed medicinal oil (Kakkolaka), and are sold in the bazaars of Bengal under the name of Kákala; they must not be confounded with Kshirakákkoli, a pseudo-bulb from Nipal, composed of from 8 to 10 ovoid fleshy scales. Kakkola and Kshirakákkoli are chiefly of interest as being the only two constituents of the *Ashtavarga* or 'group of eight medicines' which are known to the modern Hindus. The Sanskrit names of the other six plants are, Rishabha, Jivaka, Meda, Mahameda, Riddhi and Vriddhi.

CITRUS, *Several species.*

Fig.—*Bentley* and *Trim., tt.* 50 *to* 54. Orange (*Eng.*), Oranger (*Fr.*), Lemon (*Eng.*), Citronnier (*Fr.*), Citron (*Eng.*), Cedratier (*Fr.*). The fruit.

Hab.—India, universally cultivated.

Vernacular.—Narangi, Oranges; Limú, Lemons; Turúnj, Mahalung, Citrons (*Hind., Bomb.*). Kich-chilip-pazham, Oranges; Elumich-cham-pazham, Lemons; Nara-dabba, Citrons (*Tam.*). Kich-chili-pandu, Oranges; Pedda-nimmapandu, Lemons; Bijapura, Citrons (*Tel.*). Kittale, Oranges; Dodda-nimbe, Lemons; Mada-lada, Citrons (*Can.*).

History, Uses, &c.—Bitter oranges and lemons were introduced into Europe from India by the Arabians, and were used by Avicenna and the early Arabian physicians medicinally. The sweet orange was introduced from China by the Portuguese, who much improved it by cultivation, hence the European name of *Portogallotto* for this orange, and the Indian *Sangtara*, a corruption of Cintra, the name of a mountain valley near Lisbon, where the orange grows in great perfection. The Portuguese appear to have introduced the Cintra variety of orange into India towards the end of the 17th century. According to Dutt (*Hindu Materia Medica*, p. 126,) the different species of Citrus described by Sanskrit writers are as follows:—

Jambira,	*Citrus acida,*	*Roxb. Var.*	3
Limpáka,	*do.*	*do.*	1
Nimbuka,	*do.*	*do.*	2
Vijapura,	*do.*	*do.*	7
Madhukarkatika,	*do.*	*do.*	9
Mahalunga,	*Citrus medica.*		
Karuná,	*do.*	*do. Var.*	
Nagaranga,	*Citrus Aurantium.*		

"The variety of *Citrus acida*, called Jambira, yields the lemon juice used in medicine. Limpáka is much used as a sauce by the natives. The fruits are cut vertically into two pieces, and the fresh juice is sprinkled on soup, dal, curry, &c., to which it imparts a pleasant acid taste and agreeable flavour. A pickle of this fruit in its own juice and salt is a popular and effectual medicine for indigestion brought on by excess in eating, or by indigestible articles of diet. The fruits are first rubbed upon a stone, or their rind scraped a little so as to thin it; they are then steeped in juice obtained from other fruits of the sort, and exposed to the sun for a few days with the addition of common salt; when crisp and of a brown colour, they are preserved in jars. This preparation is called Járak nebu

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(digestive lemon) in Bengal. The variety called Nimbuka has larger fruit than Limpáka, and is also used as sauce, like the latter, but is inferior to it in flavour and fragrance. *Citrus Aurantium* is called Kamla nebu in Bengali; the variety grown in the plains has an acid taste, and is called Nárengá. The Sanskrit term Karuná nimbu is variously translated by different authorities. Wilson in his Sanskrit Dictionary calls it *Citrus decumana.* In the Hortus Bengalensis it is translated *Citrus medica,* while Drury and other Madras authorities make it *Citrus limonum.* The Śabdakaldruma does not give any synonym or vernacular term for it, so that it is difficult to say what form is really meant. In the vernacular the term Káruna is applied to a variety of *Citrus medica* (in the Makhzan-el-Adwiya it is given as the Hindi for Naranj), *Citrus decumana* has no Sanskrit name. In the vernacular it is called Batavi nebu, from its having been orignally brought from Batavia. Madhukarkatika is probably the sweet lemon, or possibly the citron. Lemon juice is considered cooling, refrigerant, stomachic and useful in dyspepsia, thirst, fever, &c. Fresh lemon juice is recommended to be taken in the evening, for the relief of dyspepsia with vomiting. It enters into the composition of several carminative medicines, such as the Hingváshtaka, &c. In rheumatic affections, such as pleurodynia, sciatica, lumbago, pain in the hip joints, &c. Sárangadhara recommends the administration of lemon juice with the addition of Yavakshára (impure carbonate of potash) and honey. The root of the variety of *Citrus acida,* called Limpaká, is one of the principal ingredients in a preparation of Iron called Yakridari lauha." The genus Citrus furnishes three out of the five acid fruits (*Phalámla-panchaka*) of Sanskrit writers, *viz.*, limes, oranges, and citrons; the other two are tamarinds and sorrel. Mahometan writers divide the genus Citrus into Utrunj, citrons; Náranj, oranges; and Limú, lemons; they describe two varieties of Citron—the large, which is broad and obtuse at the base, and the small, both ends of which taper equally; both are yellow and fragrant, but the perfume of the small variety is greatest; the rind of both is bitter; the pulp of the small

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bitter, of the large sweet. Citron rind is said to be hot and dry, the pulp cold and dry if acid, but cold and moist if sweet; the seeds, leaves, and flowers hot and dry. The juice is described as refrigerent and astringent, and is said to be digestive and to check bilious vomiting; the rind is tonic and digestive, and is best administered preserved with honey or sugar. The author of the Makhzan-el-Adwiya states that if the rind of a citron be steeped in a vessel of wine it will convert it into vinegar. He also quotes a Mahometan Hadis (tradition), to the effect that Satan will not enter a house in which citrons are kept. The essential oil is extracted by means of sweet oil from the powdered rind, it is considered hot and dry, and is used as a stimulating liniment. The essential oil of the flowers and leaves is extracted in the same way, and is considered to have the same properties. The seeds are generally stated to be alexipharmic. With regard to oranges, the Mahometan writers describe the best kind as large, thin-skinned, and smooth; they say that the rind and flowers are hot and dry, the pulp cold and dry, and recommend the fruit in colds and coughs, when febrile symptoms are present; it is best administered baked with sugar. The juice is valuable in bilious affections, and stops bilious diarrhœa. The orange is the safest of the acid fruits; the peel is useful for checking vomiting, and the prevention of intestinal worms. Orange poultice is recommended in some skin affections, such as psoriasis, &c. Oranges are considered to be alexipharmic and disinfectant; orange water stimulating and refreshing. The essence is extracted by oil from the rind and flowers, and is used as a stimulating liniment. Lemons are stated in the Makhzan-el-Adwiya to be of many kinds; those which are thin-skinned and about the size of a hen's egg are most esteemed; others are described as ovoid and as large as a goose egg. Of all, the juice is the most valuable part; the peel has the same properties as orange peel, but is weaker. The juice is stated to be cold and dry, or, according to some, cold and moist; to be detergent, useful in bilious headaches, and vomiting caused by excess of bile; to purify the blood in scorbutic states of the system; preserved with sugar or honey lemons are recommended for sore throat, and are considered to act as a detergent; they are administered before purgatives to prepare the body for them, and afterwards to check excessive action. Hakíms pretend to dissolve jewels and pearls in the juice, and also in that of the citron. The seeds are said to be alexipharmic, and the leaves to have the same properties as those of the citron. Sweet limes and crosses with the orange and citron, produced by tying the trees together, are considered inferior in medicinal properties. Gibson tells us that the fruit of *Citrus Bergamia* (the common sour lime of India) eaten daily with salt, is a remedy of the utmost importance in enlargement of the spleen. Dr. Aitkin (*Brit. Med. Journ.*, Oct. 4, 1884, 653,) reports that a decoction of lemons proves to be a very valuable remedy in the treatment of ague. A dose is prepared by cutting a lemon into thin slices, adding three teacupfuls of water, boiling until reduced to one teacupful, and allowing the decoction to stand all night in the open air, when, after being strained, it is ready for administration, and should be given the first thing in the morning. This statement lends interest to an investigation by M. Tanret of some immediate principles in the rind of the bitter orange. (*See Chemical comp.*)

Microscopic structure of Orange and Lemon Peel.—The epidermis exhibits numerous stomata; the parenchyme of the pericarp encloses large oil cells, surrounded by small tabular cells. The inner spongy tissue consists of branched cells separated by intercellular spaces. The outer layers of the parenchyme contain numerous solid yellow bodies, which probably consist of Hesperidin; large crystals of oxalate of calcium are also to be seen, and in the interior tissue vascular bundles.

Chemical composition.—The following estimates of citric acid in East Indian limes has been kindly furnished to us by Mr. G. W. R. Criper, F. C. S., of Calcutta:—

1*st*, *Chholonga*, a large oblong fruit with a rough skin of a reddish-yellow colour (*Citrus medica, Roxb.*). One fruit contains approximately 100 c. c. juice, = 6·3 per cent. acid calculated as citric.

2nd, China Páti, a round small fruit with a smooth skin of a yellow colour. (*Citrus acida, Roxb.*, var. 1.) One fruit contains 40—50 c. c. juice = 6·5 per cent. acid calculated as citric. 50 of these limes gave 69 fl. oz. juice.

3rd, Kághazi, a small oblong, smooth-skinned fruit, greenish to yellow in colour. (*Citrus acida, Roxb.*, var. 2.) One fruit contains 18—25 c. c. juice = 6·4 per cent. acid, calculated as citric.

4th, Páti, a small round smooth-skinned fruit of a yellow colour. (*Citrus acida, Roxb.*, var. 1.) One fruit contains about 40 c. c. juice = 7 per cent. acid, calculated as citric.

5th, Gora, an oblong rough-skinned fruit of a greenish colour. (*Citrus acida, Roxb.*, var. 3.) One fruit contains about 40—50 c. c. juice = 5·6 per cent. acid, calculated as citric.

6th, Sharbati (Sweet lime), a round smooth-skinned fruit of a pale yellow colour. (*Citrus acida, Roxb.* var. 9.) One fruit contains about 60 c. c. juice = 0·1 per cent. acid, calculated as citric.

The white spongy inner coating of lemons, as well as other fruits of the genus *Citrus*, contains a bitter principle, *Hesperidin*, discovered by Lebreton (*J. Pharm. XIX.*, 377), of which E. Hoffmann obtained 5 to 8 per cent. from unripe bitter oranges. He extracted them with dilute alcohol, after they had previously been exhausted by cold water. The alcohol should contain about 1 per cent. of caustic potash; the liquid on cooling is acidulated with hydrochloric acid, when it yields a yellowish crystalline deposit of hesperidin, which may be obtained colourless and tasteless by recrystallization from boiling alcohol. By dilute sulphuric acid (1 per cent.) hesperidin is broken up as follows:—

$$\underset{\text{Hesperidin}}{C^{22} H^{26} O^{12}} = \underset{\text{Hesperetin}}{C^{16} H^{14} O^{6}} \qquad \underset{\text{Glucose.}}{C^{6} H^{12} O^{6}}$$

Hesperidin is very little soluble even in boiling water or in ether, but dissolves readily in hot acetic acid, also in alkaline solutions, the latter then turning soon yellow and reddish. Pure hesperidin, as presented to one of us by Hoffmann, darkens when it is shaken with alcoholic perchloride of iron, and turns dingy blackish brown when gently heated with it. Under the same name Wiedemann has described a principle obtained from unripe oranges differing from ordinary Hesperidin in some respects, especially in being insoluble in alcohol.

Hesperetin forms crystals melting at 223° C., soluble both in alcohol or ether, not in water; they taste sweet. They are split up by potash into phloroglucin and *Hesperetic acid*, $C^{10} H^{10} O^{4}$. On addition of ferric chloride, thin slices of the peel are darkened, owing probably to some derivative of hesperidin or to hesperidin itself. The name hesperidin has also been applied to *yellow* crystals extracted from the Pomelo, *Citrus decumana, Linn.*, the dried flowers of which afford about 2 per cent. of this substance. It is, as shewn in 1879 by E. Hoffmann, quite different from hesperidin as described above; he calls it *Naringin*, and assigns to it the formula $C^{23} H^{26} O^{12} + 4 OH^{2}$. Naringin is readily soluble in hot water or in alcohol, not in ether or chloroform. Its solutions turn brownish red on addition of ferric chloride. Lemon juice in addition to citric acid contains 3 to 4 per cent. of gum and sugar, and 2·28 per cent. of inorganic salts, of which, according to Stoddart, only a minute proportion is potash. Cossa, on the other hand, who has recently studied the products of the lemon tree with much care, has found that the ash of dried lemon juice contains 54 per cent. of potash, besides 15 per cent. of phosphoric acid. Stoddart has pointed out the remarkable tendency of citric acid to undergo decomposition, and has proved that when lemons are kept for six months the acid rapidly decreases in quantity and finally ceases to exist, having been all split up into glucose and carbonic acid. Lemon juice may with certain precautions be kept unimpaired for months or even years. (*Pharmacographia*, 2nd Ed., p. 116.) To prevent fermentation it should be heated, strained to remove albumen, and stored in well filled bottles. In the

Calcutta market lime juice prepared by native manufacturers, and preserved with a small amount of salicylic acid, is largely sold. Juice containing less than 25 grains of free citric acid per fluid ounce is not passed for Government purposes, and the amount of salicylic acid has been fixed at one-fifth of a grain per fluid ounce. Some experiments were recently made by one of us on concentrating lime juice to one-fourth its original volume in order to facilitate transport. It was found that the loss of acidity in conducting the operation in metallic dishes over a naked flame, and on the water bath at varying temperatures, with constant stirring was 53·2 to 28·8 grains per gallon. The same juice concentrated without heat in vacuo over $H^2 SO^4$, indicated a loss of only 9·2 grains due to volatile acids. In the experiments in which heat was employed the total loss of acidity, though really partly due to volatile acids, was calculated as citric acid, and to render the results comparable the loss in vacuo over $H^2 SO^4$ was also calculated as citric acid. On the large scale without using vacuum pans a greater loss occurs. Warnecke found 5·85 per cent. of ash in immature orange fruit, 3·90 per cent. in the pulp of the ripe fruit, and 5·28 per cent. in orange peel when the white inner tissue had been removed. According to Boussingault, orange petals contain 5·00 per cent. of sugar capable of reducing copper solution. Several species of the genus yield an inferior gum resembling cherry-tree gum. By various treatment of an alcoholic extract of the peel, M. Tanret has succeeded in separating—

(*a*) A crystalline acid, insipid and non-volatile, insoluble in water and ether, slightly soluble in cold alcohol, but more soluble in boiling alcohol and chloroform, and having a composition represented by the formula $C^{44} H^{28} O^{14}$;

(*b*) A crystalline resinous body, extremely bitter, nearly insoluble in cold water, but freely soluble in boiling water and in ether, alcohol and chloroform, and having a composition approximating to that of hesperetic acid;

(*c*) A crystalline glucoside, isomeric with hesperidin, and named isohesperidin.

(*d*) Hesperidin; and (*e*) a glucoside to which the bitterness of the peel is attributed, and which has been named "*aurantiamarin.*" Aurantiamarin is soluble in all proportions in water and in alcohol, but is insoluble in ether and chloroform. It is the natural solvent of hesperidin and the bitter resin (*b*). (*Comptes Rend. cii.,* 518; *Pharm. Journ.* 1886.) The sugar produced when hesperidin and isohesperidin are split up under the action of acids is a mixture of glucose and insodulcite. (*Bull. Soc. Chim.* xlix., 1.)

The rind of the lemon yields the oil of lemon of commerce. The most delicate scented oil is procured by the *sponge process* in use in Italy and Sicily. After soaking in water to which a little soda has been added, the fruit are taken up singly, and firmly pressed against a large and hard-grained sponge. Two or three sharp turns of the wrist causes the sponge to rupture the oil cells in the rind, and the sponge absorbs the exuded oil. The sponge is pressed from time to time, and the expressed liquid allowed to settle, when it separates into three layers, the oil floating on the surface, bright and clear. In Southern France, an instrument called an écuelle is used, which consists of a shallow pan studded on its concavity with strong blunt spikes, and having a receptacle at its lowest part for the oil, and a lip on one side. In using the instrument the fruit is rolled by the hand gently and quickly over the spikes, when the oil separates and collects in the reservoir. Another plan of obtaining the oil is expression. The process of distillation is also used, but the product is inferior. A combined process in which the écuelle and distillation methods are used has been introduced, and it is claimed that while the product is equal in quality to that yielded by mechanical means, the yield is nearly double. One thousand lemons yield from 320 to 400 grams of oil, and about ten gallons of raw juce. Pure oil of lemons contains, according to Bouchardt and Lafont, besides a little cymene, several hydrocarbons, $C^{10} H^{16}$, the most abundant of which is a citrene boiling at about 178° C., and having a rotatory power exceeding + 105,° and yielding a solid optically inactive dihydrochloride.

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Oil of limes, derived from the rind of *C. Limetta,* is obtained in a similar manner to oil of lemons, which it somewhat resembles

Orange peel oil, the essence or oil of Portugal of commerce, is also obtained in a similar manner. Wright has isolated from the oil a terpene Hesperidene. (*J. Chem. Soc.*, 1873, p. 549.)

From the flowers of different varieties of the Orange, *oil of Orange flowers* is obtained. Genuine orange flower oil, the *Oleum Neroli* of pharmacy, is obtained by the maceration or absorption process from the flowers of the sweet or bitter orange. By aqueous distillation of the flowers oils are also obtained, but inferior in aroma to that yielded by the first mentioned methods. Thus *C. Aurantium* yields *oil of neroli*, the flowers of *C. bigaradia,* or Seville orange, *néroli bigarade*; while the leaves and young unripe fruit of different varieties of Citrus yield *néroli petit grain*. (Brannt.)

Orange flower water is used in pharmacy, and a tea made from orange flowers is much used in French domestic medicine.

Commerce.—The various species of Citrus are cultivated in most parts of India. The kinds usually met with are: several varieties of Mandarin orange; the common sweet orange; several varieties of sour lime; the sweet lime; the citron; and a fruit which appears to be a cross between the sour lime and orange. Besides these we have the Shaddock or Pummelo in abundance, and occasionally sweet citrons from the Persian Gulf, and sweet oranges from Suez or Zanzibar. Sour limes in a dried state are exported to Arabia, where they are used as a condiment with fish, meat, &c.

ÆGLE MARMELOS, *Corr.*

Fig.—*Bentl. and Trim.*, *t.* 55. Bael tree (*Eng.*), Egle marmel (*Fr.*). The fruit, bark, leaves and root.

Hab.—India.

Vernacular.—Bél (*Hind.*, *Beng.*, *Bomb.*), Vilva-pazham (*Tam.*), Bilva-pandu (*Tel.*), Bilapatri (*Can.*), Bilinu-phal (*Guz.*).

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History, Uses, &c.—This is a sacred tree amongst the Hindus, its leaves being used in the worship of Siva. On this account it is to be found cultivated everywhere in Hindu gardens. It is considered sacrilegious to destroy it; enormous quantities of the leaves are gathered for use in the temples at certain seasons. In ancient Sanskrit poems it is frequently alluded to as an emblem of increase and fertility, it is considered to be very auspicious (ati-mangalya). The baton of the Vaisya or third caste of Hindus is obtained from this tree. The fruit is the subject of several Solar-phallic myths. Hindu physicians regard the unripe or half ripe fruit as astringent, digestive, and stomachic, and prescribe it in diarrhœa and dysentery. The ripe fruit is considered aromatic, cooling and laxative. A thick sherbet of the ripe fruit has a reputation among Europeans as an agreeable laxative; the dose is a tumbler-full. The dried pulp of the fruit is called Vilva peshika in Sanskrit. The root bark is used as a remedy in hypochondriasis, melancholia and palpitation of the heart (diseases supposed to be caused by deranged air); it is one of the Dasamula or ten plants (*vide Tribulus terrestris*). The fresh juice of the leaves is given with honey as a laxative and febrifuge; it is used in asthmatic complaints, and with the addition of black pepper in anasarca with costiveness and jaundice; moreover, in external inflammations it is given to correct the supposed derangement of the humours. The Mahometans use the Bel as a medicine, and Muhammad bin Zakarieh describes it; they consider the ripe fruit to be hot and dry, the very young fruit cold in the second degree, and the half ripe fruit cold in the first and dry in the second degree; its properties are described in the Makhzan-el-Adwiya as cardiacal, restorative, tonic and astringent; it is directed to be combined with sugar for administration to prevent its giving rise to piles. The pulp of the half-ripe fruit baked and mixed with sugar and rose water when given on an empty stomach is said to be a good remedy for diarrhœa. Garcia d'Orta, physician to the Viceroy of Goa in the 16th century, describes the Bel fruit under the name of Marmelos de

Bonguala, and mentions its use in dysentery. Bontius also mentions it. Rheede in his *Hort. Malab.* (Vol. iii., p. 37,) notices its use on the Malabar Coast. Rumphius remarks that the gum is like cherry gum, it tastes at first sweet but afterwards slightly acrid. He also tells us that the Chinese make an extract of the leaves and young fruit which they use for adulterating opium. Ainslie and the author of the Bengal Dispensatory quote Rheede, but give no further information upon the use of the fruit in dysentery. In 1853, Sir B. Martin, writing in the *Lancet* (Vol. II., p. 53,) called the attention of the profession to it; finally, in 1869, it was made official in the Pharmacopœia of India, where it is recommended as a remedy of much value in atonic diarrhœa and dysentery and in the advanced stages of those diseases, in irregularity of the bowels, and in habitual constipation. In the Concan the small unripe fruit (Bál belphal) is given with fennel seeds and ginger in decoction for piles; a compound pill containing two parts each of Bál belphal, *Mimusops elengi* fruit, and galls, one part each of nutmegs, cloves, saffron, nágkesar and mace, is used as a remedy for diarrhœa; the dose is one pill for a child and three for an adult. Two tolás of the juice of the bark is given with a little cummin in milk as a remedy for poverty of the seminal fluid. The best preparation of Bael fruit is a marmelade made from the full grown but still tender fruit cut in thin slices; it keeps well, which is not the case with the conserve made from the pulp of the ripe fruit usually met with in the shops.

Description.—The fruit is a large berry, 2—4 inches in diameter, variable in shape, being spherical or somewhat flattened like an orange, ovoid, or pyriform, having a smooth hard shell; the interior divided into 10—15 cells, each containing from 6—10 woolly seeds, consists of a mucilaginous pulp, which is very aromatic, each seed is surrounded by a clear tenacious mucus. The commercial article is entire or in dried slices, having on the outer side a smooth greyish brown shell, enclosing a hard orange brown gummy pulp, in which the

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cells and seeds may be seen; the latter are oblong and compressed, about 3 lines long, and covered with whitish hairs; the dried pulp has a mucilaginous, acid, and slightly astringent taste, and a very agreeable aroma, resembling that of elemi.

Microscopic structure.—The rind is covered with a grey cuticle or bloom, and further shows two layers, the one exhibiting not very numerous oil cells, and the other and inner made up of sclerenchyme. The tissue of the pulp consists of large cells. In the epidermis of the seeds certain groups of cells are excessively lengthened and constitute the woolly hairs already noticed.

Chemical composition.—As stated in the *Pharmacographia*, the dry pulp moistened with cold water yields a red liquid containing chiefly mucilage and (probably) pectin, which separates if the liquid is concentrated by evaporation. The mucilage may be precipitated by neutral acetate of lead or by alcohol, but is not coloured by iodine. It may be separated by a filter into a portion truly soluble (as proved by the addition of alcohol or acetate of lead) and another, comprehending the larger bulk, which is only swollen like Tragacanth, but is far more glutinous and completely transparent. Neither a per nor a proto salt of iron shows the infusion to contain any appreciable quantity of tannin. Warden remarks that the ripe and unripe fruit, when moistened with a solution of ferric chloride gives a marked tannic acid reaction, strongest in those portions of the pulp next the rind, the clear mucilage surrounding the seeds he found to have an acid reaction, to contain lime and to afford no tannin reaction. Warnecke found 2·08 per cent. of ash in Bael fruit, and 3·72 per cent. in the pulp separated from the rind. The wood has the following percentage composition:—

Soluble potassium and sodium compounds	·16
Phosphates of calcium and iron	·13
Calcium carbonate	2·16
Magnesium carbonate	·19
Silica with sand and other impurities	·01

—(*Warth., Indian Forester X.*, p. 63.)

28 lbs of the fresh leaves submitted to distillation in the usual manner, rapidly yielded one ounce of a thin mobile oil of a faint yellowish-green colour and neutral reaction, which had a peculiar aromatic odour and slightly bitter taste. It had a specific gravity of 0·835 at 32° C. and a boiling point of 175° C. Examined with the polariscope it turned a ray of polarized light to the left $(\alpha)_D = -22{\cdot}87$. The oil was miscible with carbon bisulphide in all proportions, readily soluble in alcohol, and one part in three of 84 per cent. alcohol. It gave a reddish-brown colour with sulphuric acid, a deep brown with sulphuric acid and potassium bichromate, a reddish coloration with fuming nitric acid. It dissolved picric acid when slightly warmed, and the solution had a deep orange colour; on cooling crystals were deposited. With a solution of bromine in chloroform it formed a colourless solution. Dissolved in carbon bisulphide, and nitric acid 1·2 added, the upper layer of bisulphide showed a greenish colour and the lower of acid a red colour. The oil dissolved iodine with explosive action, and was soluble in glacial acetic acid. (*H. R. Hoyles.*)

Commerce.—Value, dry fruit, ¾ to Re. 1 per 100; green fruit 6 as. per 100; dry pulp, Rs. 20 per cwt. The Bombay market is chiefly supplied from the Deccan. The fruits are usually small and not suitable for the preparation of the conserve; for this purpose the large cultivated fruit of Bengal should be obtained in a fresh condition. Season November and December.

FERONIA ELEPHANTUM, *Corr.*

Fig.—*Roxb. Cor. Pl.*, *t.* 141; *Wight Ic.*, *t.* 15. Wood Apple (*Eng.*), Pommier d' éléphant (*Fr.*).

Hab.—India. The leaves, fruit and gum.

Vernacular.—Kowit, Kavitha (*Hind.*, *Mar.*), Kathbel (*Beng.*), Nila-vilam (*Tam.*), Kotha (*Guz.*), Byalada (*Can.*), Nela-veluga (*Tel.*).

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History, Uses, &c.—The Wood apple, or Elephant apple, so called because the fruit is like an elephant's skin, in Sanskrit Kapittha (on which monkeys dwell) and Kapipriya (dear to monkeys), is met with throughout India, and is cultivated for the sake of the fruit, which is edible. The Hindus consider the unripe fruit to be a useful astringent in diarrhœa and dysentery, and prescribe the ripe fruit in affections of the gums and throat. It is called Dadhiphala in Sanskrit, as its taste is compared with that of Dadhi or coagulated milk. The leaves are aromatic and carminative. The author of the Makhzan-el-Adwiya says that the leaves are very astringent, and have the taste and odour of Tarragon. He describes the fruit as cold and dry in the second degree, refreshing, astringent, cardiacal and tonic, a useful remedy in salivation and sore throat, strengthening the gums and acting as an astringent; sherbet made from the fruit increases the appetite, and has alexipharmic properties. The pulp applied externally is a remedy for the bites of venomous insects; if not obtainable, the powdered rind may be used Ainslie mentions the use of the fruit, leaves, and gum. He says that the latter supplies the place of gum Arabic in Lower India, and is prescribed by Tamool practitioners to relieve tenesmus in bowel affections. The *Feronia elephantum* is the Balong of the Portuguese. It is mentioned in the Bengal Dispensatory and Pharmacopœia of India, but no further information as to its properties is to be gathered from these works. The fruit when cultivated, attains a diameter of four inches. The gum forms part of the country gum which is sold in the bazárs. It is the Dadhittharasa of Sanskrit writers. Under the name of Pancha-kápittha, or five products of the Feronia, the Hindus prepare a medicine which contains the flowers, bark, root, leaves and fruit of the tree. The country people pound the leaves with curds and apply the mixture to the whole body as a remedy for heat of blood supposed to be caused by bile.

Description.—The ordinary wood apple is globose, one-celled, about 2½ inches in diameter, covered with a scurfy

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epidermis, which is of a light grey or dirty white colour; beneath the epidermis, the rind is dull green, woody and granular, much more fragile than that of the Bél. The odour when ripe is aromatic, and resembles that of melon. There are about 500 seeds in each fruit of a bland taste and free from bitterness; they are embedded in a pale greyish-pink pulp, and are of an oblong compressed form, with thick fleshy cotyledons, and a radicle pointing away from the hilum. The leaves have from 5—7 leaflets, cuneate, or obovate with a crenate tip; they smell aromatic. The root bark is thick, white and starchy; it has the odour of the leaves and contains essential oil. The gum is in tears or irregular masses, yellow or brownish; dissolved in water it forms an almost tasteless mucilage, much more viscid than that of gum Arabic made in the same proportions. The solution reddens litmus, and is precipitated by alcohol, oxalate of ammonia, alkaline silicates, perchloride of iron, but not by borax. Moreover, the solution is precipitated by neutral acetate of lead or caustic baryta, but not by potash. If the solution is completely precipitated by neutral acetate of lead, the residual liquid will be found to contain a small quantity of a different gum, identical apparently with gum Arabic, inasmuch as it is not thrown down by acetate of lead. If the lime is precipitated from the Feronia mucilage by oxalate of potassium, the gum partially loses its solubility and forms a turbid liquid.

Chemical composition.—The larger portion of Feronia gum is not identical with gum Arabic; when examined in a column of 50 mm. length, it deviates the ray of polarised light 0°·4 to the right,—not to the left, as gum Arabic. Gum Arabic may be combined with oxide of lead; the compound (arabate of lead) contains 30·6 per cent. of oxide of lead, whereas the plumbic compound of Feronia gum dried at 110° C. yields only 14·76 per cent. of Pb O. The formula $2\,(C^{12}\,H^{21}\,O^{11})\,2\,Pb + 2\,(C^{12}\,H^{22}\,O^{11})$ supposes 14·2 per cent. of oxide of lead. Feronia gum repeatedly treated with fuming nitric acid, produces abundant crystals of mucic acid. Dried at 110° C. it

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yields about 17 per cent. of water. The ash amounts to about 3·55 per cent. (*Pharmacographia, p.* 212.)

The pulp of the fruit contains citric acid and mucilage. If the pulp is thoroughly dried in a water bath, and then covered with water for about five minutes, an almost pure solution of citric acid is obtained and recognised by the usual reagents; if left in contact with water for a longer period, the gum begins to enter into solution. The dried pulp contains 15 per cent. of citric acid, and a small quantity of deliquescent ash consisting of potassium, calcium and iron salts.

The leaves yield to distillation a small quantity of essential oil similar to that obtained from Bael leaves. (*See Ægle Marmelos.*)

Commerce.—The gum, or rather the mixed gums of which Feronia gum forms a part, is known as Ghati gum. In London these mixed gums are known as Amrads, and the term Ghati is applied to the gum of *Conocarpus latifolia.* The term Amrad is unknown in India, and appears to be of African origin, and to be applied to coloured Acacia gums.

SIMARUBEÆ.

BALANITES ROXBURGHII, *Planch.*

Fig.—*Wight Ic., t.* 274. Egyptian myrobalan (*Eng.*), Balanite Agihalad (*Fr.*)

Hab.—Drier parts of India, Egypt. The fruit.

Vernacular.—Hingan, Ingua, Hingol (*Hind.*), Hingon (*Beng.*), Nanjundan (*Tam.*), Gári, Ringri (*Tel.*), Hingana (*Mar.*), Hingoria (*Guz.*).

History, Uses, &c.—This plant is sacred to Isis, who is represented with a crown of it in her hand. In Egypt it was also a symbol of farewell and hope given to dying people. The seeds are found along with other fruit seeds in the Egyptian tombs. The Greeks appear to have become acquainted

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with the tree through the Egyptians, and it is mentioned by Hippocrates, Theophrastus, Strabo and Dioscorides under the name of Persea—περσέα. Dioscorides says that the dried leaves are applied to blood eruptions, and that the fruit is often infested by an insect called κρανοκόλαπτον. Latin writers also notice the tree being sacred to Isis, and Pliny (15, 13.) says that Alexander gave orders that the victors should be crowned with it in the games which he instituted in honour of Perseus at Memphis. The fruit appears to have been occasionally confounded by the ancients with the Persica or peach, as it is sometimes described as edible. Baillon says that in Egypt the ripe fruit is called "desert date" and the unripe "Egyptian myrobalan." The African Arabs call the tree *El Heglyg*, and use the pulp as a detergent, and the bark to poison fish. In Senegambia the leaves are used as a vermifuge, and the roots and fruit as a purgative. (*Corre et Lejanne.*) In India Balanites is the Ingudi or Ingua of Sanskrit writers, who also call it Tápasa-taru and Munipádapa, "anchorite's tree," because the Gurus prepare from the seeds an oil for the lamp which they use in the ceremony of *Guru-upásana*, or initiation of a Hindu by his spiritual guide. Another name for the fruit is Gauri-tvac, which seems to connect it with the worship of Gauri or Isani, the Indian goddess of abundance, the earth, the *sakti* or power of Isvara or Mahadeva, in whose honour bombs made with the shell are exploded. The festival of this goddess, called *Kátyayanivrat*, is conducted by women at the vernal equinox; an interesting description of it under the name of the Gangore festival will be found in Tod's *Rajasthan* (Vol. I., p. 570). In all parts of India a boat is used as described by Herodotus in the Isis worship at Busiris, and by Tacitus in the Ertha worship among the Suevi in Germany. At the Ganpati festival in India, Gauri is worshipped in the form of a cornucopœia-shaped bouquet of leaves and flowers, and a similar emblem appertained to the Demeter or Ceres of the Greeks. Gauri also holds in her hand a Lotus flower as emblematic of reproduction. The leaves of Balanites are the Hingupatri of modern Sanskrit writers, but the true Hingu-

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patri was doubtless the Asafœtida leaf. In the Concan and in other parts of India where this tree is unknown, the oil for the Guru-upásana ceremony is obtained from *Terminalia Catappa*, a tree which is not a native of any part of India except perhaps the eastern borders of Bengal.

The unripe fruit of Balanites is found in the druggist's shops in many parts of India, and is used as a purgative and anthelmintic, the dose being half of the pulp of a single fruit; in smaller doses of from 2—20 grains it is expectorant. The bark, unripe fruit, and leaves are given to cattle as an anthelmintic. The physiological action of the bark and fruit is similar to that of the genus Polygala, and a few drops of a tincture of the fruit is as efficient an emulsifier as Tincture of Senega. The kernel yields a bland fatty yellow tasteless oil, which is applied to burns and sores.

Description.—The fruit is an ovoid drupe, about two inches long, by 1½ inch broad, having a nearly smooth, fragile epicarp, marked by ten shallow longitudinal grooves; the greenish soapy mesocarp is traversed by numerous bundles of vascular fibres, and is adherent to the pentagonal, thick, woody shell. The descending seed contains under its coats a thick ex-albuminous embryo, with plano-convex cotyledons sometimes unequal, bilobed or corrugate, and a short superior radicle. As found in the shops, the fruit presents a wrinkled appearance, and is of a greenish-yellow colour, having been gathered a little before maturity.

Chemical composition.—The bark yields a principle similar to, if not identical with saponin. (*See* Saponaria.) The oil (*Zachun oil* of Africa) has a sp. gr. of ·9185 at 15·5° C., and congeals at zero. It yields 94·4 per cent. of crystallized fatty acids melting at 31°, and with a mean combining weight of 277. Sulphuric acid produces a brown colour not altered by stirring. With Massie's nitric acid test the oil becomes opaque, and is only slightly darkened in tint; the lower part of the oil becomes white and solid with a green ring where it touches the acid. Heated with a third of its weight of nitric acid, it changes.

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to a light orange liquid, and when left to cool becomes solid in a few hours. It is a slow drying oil, and is readily bleached in sunlight. There are some points of resemblance between it and that of *Arachis hypogœa.* The seeds yield to solvents a little more than 50 per cent.

The pulp of the fruit contains organic acids 1·8 per cent., saponin 1·32 per cent., besides mucilage and sugar.

PICRASMA QUASSIOIDES, *Benn.*

Hab.—Sub-tropical Himalaya, South China. The wood and bark.

Vernacular.—Kashshing (*Hind.*).

History, Uses, &c.—A small tree or large bush with unequally pinnate leaves, and the aspect and foliage of Ailantus; it bears axillary stalked cymes of small diœcious or polygamous flowers, which have the calyx four or five parted. The fruit is a pea-like red drupe and is edible. Royle first drew attention to the bark and wood as being quite as bitter as quassia, and Stewart states that the leaves are used in the Punjab to cure scabies and the wood to kill insects. The bark has been recommended by Macardieu as a febrifuge, and under the name of *Brucea* (*Nima*) *quassioides*, the plant is noticed as a likely substitute for quassia in the Indian Pharmacopœia. In this work the bark is said to be sold under the name of *Bharangi* in Bengal, but this we are unable to confirm, as several samples of bharangi which we have obtained in Bengal and elsewhere all proved to be the roots and stems of *Clerodendron serratum.*

Description.—The wood consists of pieces of the larger branches from 3 to 6 inches in diameter, and is covered with a dark-brown bark, which has a somewhat netted surface, and is marked by transverse scars. On rubbing off the outer layer of suber an olive-green surface is exposed. The bark from a stem of 3 inches in diameter was ¼ inch thick and very

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compact. The wood and bark are of a light yellow colour; in the former a transverse section shows numerous fine, close, medullary rays, which intersect well marked, irregular, concentric rings. The centre of the stem is occupied by a cylinder of pith—in short, in appearance and taste the drug bears a close resemblance to quassia.

Under the microscope a transverse section of the bark exhibits an outer layer of brown suber, within which are two or three rows of empty transparent cells, followed by 8 to 10 rows of cells containing chlorophyll; these are succeeded by the liber tissue, which is divided into layers by about six rows of yellow stone cells. Lastly comes the cambium layer.

The medullary rays consist of about 15 vertical layers of cells; the single layers contain from one to five rows of cells. The tissue of the bark contains resinous deposits and crystals of oxalate of lime, which are so numerous towards the exterior portion that they produce opaque patches, visible to the naked eye.

The wood so closely agrees with the microscopic description of quassia by Pocklington (*Pharm. Jn.* (3) *V.*, 321, *Year-Book*, 1875, p. 190), that we think it unnecessary to reproduce the particulars.

Chemical examination.—Our experiments indicate that the wood contains a crystallizable principle, probably quassiin, a fluorescing, bitter, resin-like principle, and at least one other non-crystallizable, bitter, resinous body, probably the uncrystallizable quassiin of Adrin and Mordeaux. There are several points of interest connected with the examination of *P. quassioides* to which we would refer. Firstly, the wood is not so bitter to the taste as ordinary quassia wood. Secondly, the authors of the *Pharmacographia* state that they obtained 7·8 per cent. of ash from quassia wood dried at 100° C.; the ash of *P. quassioides* obtained by us amounted to only 1·7 per cent. Thirdly, a watery solution of ordinary quassia wood is stated to display a slight fluorescence, especially if a little caustic lime has been added. According to Flückiger and

Hanbury this is apparently due to quassiin. We have repeated the experiment with a sample of ordinary quassia wood with negative results. The *P. quassioides* wood when treated with water or alcohol affords solutions which display a very marked greenish fluorescence. Regarding the content of quassiin it appears to vary considerably. A. Christensen (*Archiv. der Pharm.* (3) XX., 481,) states that he found the amount to vary greatly, some specimens yielding scarcely any. Stillé and Maisch give the yield at 0·15 to 0·05 per cent. (*National Dispensatory.*) The authors of the *Pharmacographia* at about 0·1 per cent. MM. Adrin and Mordeaux—(*Repert. der Pharm.* XI., 246—50) obtained 0·125 to 0·15 per cent. of white crystalline quassiin. Oliveri and Denars (*Gazetta Chim. Ital.* XIX., 1—9) obtained only 0·03 per cent. of the pure principle. While Goldschmiedt and Weidel in 1877 failed to isolate quassiin, they obtained however a yellow resin, the presence of which had been previously noticed in the wood by Flückiger and Hanbury. The amount of crystallizable principle present in the wood we examined, we are unable to accurately give; as a rough approximation we do not consider that it would amount to more than ·02 to ·03 per cent. as an outside limit.

Regarding the methods of analysis, extraction of the wood by alcohol, and subsequent boiling of the dry alcoholic extract with water, concentrating, and precipitating with tannin, appears to give the best results, as far as a crystalline product is concerned.

In order to ascertain whether any of the Jaborandi alkaloids were present in the wood or not, we made the following experiments:—An alcoholic extract of the wood was digested with water acidulated with one per cent. hydrochloric acid, the solution filtered from insoluble resinous matter, and evaporated to a small bulk. When cold the deep yellow solution was precipitated with phosphomolybdic acid, filtered, and the precipitate washed with water containing a trace of hydrochloric acid. The precipitate was then treated with baryta water, the excess of barium removed by CO^2, and the liquid with precipitate evaporated to dryness. The residue was then boiled with 96 per cent. alcohol. On evaporating off the alcohol a yellow non-crystalline varnish-like residue was left. This residue was bitter, partly soluble in water, and responded to the usual alkaloidal re-agents. The amount obtained did not exceed a trace.

The method of extraction above described was subsequently modified in the following manner:—

An alcoholic extract obtained from 263 grams of the wood was digested at a gentle heat for some hours with water acidulated with 2 per cent. of hydrochloric acid. The deep yellow solution was filtered, rendered alkaline with ammonia, and agitated with chloroform. The separated chloroform was then agitated with dilute hydrochloric acid, the acid liquid decanted, made alkaline with ammonia, and again agitated with chloroform; and this operation was repeated a second time. Finally the chloroform was evaporated off, and left an amber-coloured non-crystalline, transparent varnish-like residue. In water this extract was only slightly soluble, but in water acidulated with a few drops of nitric acid, it was wholly soluble, with the exception of a few flakes. On spontaneous evaporation of the nitric acid solution a yellowish non-crystalline residue was obtained, not easily soluble in cold 96 per cent. alcohol, slightly soluble in cold water, and not wholly soluble in warm water. An aqueous solution was of a deep yellow colour and possessed the following properties: Taste distinctly pungent, very slightly bitter and acrid. With alkaloidal group re-agents very marked precipitates were obtained; with very dilute solution, however, phosphomolybdic acid was one of the few re-agents which afforded a reaction. Fröhde's re-agent gave no colour reaction in the cold or on heating. The physiological action of the principle was tried by the following experiments:—A solution containing ·0009 gram of the principle injected hypodermically below the skin of a frog produced no symptoms; a solution containing about ·002 of a gram hypodermically injected below the skin of a cat's thigh yielded negative results; one of us swallowed a solution containing ·0036 of a gram without any symptoms whatever ensuing. A strong solution applied to a cat's eye caused no contraction of the pupil.

The amount of this principle separated from the wood, though we had operated on a fairly large amount, was insufficient for further experiments. Our experiments indicate however the presence of a distinctly alkaloidal principle in the wood, in addition to the principles already referred to. As far as our experiments have gone there is no evidence to show that the alkaloidal principle is related to the Jaborandi alkaloids. We have also examined *P. nepalensis* for these alkaloids with a negative result. It however contains an alkaloid which does not appear to be identical with that found in *P. quassioides*.

AILANTUS EXCELSA, *Roxb.*

Fig.—*Roxb. Cor. Pl., t.* 23; *Wight, Ill. I., t.* 67.

Hab.—Behar, W. Peninsula. The bark and leaves.

Vernacular.—Maharukh, Mahanimb, Arua (*Hind.*), Maharukh (*Mar.*), Peru-maram (*Tam.*), Pedda-mánu (*Tel.*), Doddamari (*Can.*), Motho-araduso (*Guz.*).

History, Uses, &c.—It appears probable that this is one of the trees to which Sanskrit writers have given the name of Mahanimba. Its bark and leaves are in great repute as a tonic in Southern India, especially in debility after childbirth. The juice of the leaves is usually administered in *khir* (a kind of rice milk), or the juice of the fresh bark is given with cocoanut milk and treacle, or with aromatics and honey; it is said to stop after-pains. Ainslie says that the bark has a pleasant and somewhat aromatic taste, and is prescribed by native practitioners in infusion in dyspeptic complaints to the extent of three ounces twice daily, but from his description of the bark, it appears probable that he refers to *A. malabarica*, which bears the same Tamil name, the bark of *A. excelsa* being

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intensely bitter like Quassia. Dr. Wight mentions that in the Circars the bark is regarded as a powerful febrifuge, and as a tonic in cases of debility.

Description.—Bark light coloured, very thick and granular, externally hoary, rough from the presence of numerous longitudinal scabrous ridges; internal surface yellowish white and finely fibrous; when soaked in water it swells greatly, and becomes glutinous on the surface; odour when moist acrid and disagreeable; taste very bitter. The leaves are abruptly pinnated, tomentose when young, afterwards glabrous, leaflets 10—14 pair, 4—5 inches long, coarsely toothed at the base; taste bitter and somewhat aromatic

Microscopic structure.—Sections for the miscroscope show that a great portion of the bark consists of large stony cells collected together in groups. There also many conglomerate raphides.

Chemical composition.—Dr. N. Dáji has separated from the bark an acid principle which he has named *ailantic acid.* It is reddish-brown, very bitter, and forms a deliquescent mass of waxy consistence, very easily soluble in water, less so in alcohol and ether, and insoluble in chloroform and benzol. (*Pharm. Jn.* (3) I., 154.)

AILANTUS MALABARICA, *DC.*

Fig.—*Rheede Hort. Mal. vi., t.* 15.

Hab.—Western Peninsula, Ceylon.

Vernacular.—Ood (*Mar.*), Peru-maram (*Tam.*), Pedda-manu (*Tel.*), Hem-mara (*Can.*).

History, Uses, &c.—This tree grows along the edge of the Ghauts on the Western Coast. It is the Pongelion of Rheede, who gives Sarala* as the Brahminic name. The resin is known as Baga-dhup in Canara, and in Travancore as

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* सरल is the Sanskrit name for *Pinus longifolia.* The resin of *A malabarica* appears to be regarded as a substitute for Pine resin in Southern India.

Matti-pal. The bark has a pleasant, astringent and slightly bitter taste, is given in cases of dyspepsia and dysentery, and is also considered a valuable tonic and febrifuge. Reduced to powder, mixed with milk and strained, the resin is given in small doses in dysentery and also in bronchitis, and is reputed to be an excellent remedy, chiefly owing to its balsamic properties. The fruit, triturated with mango, and mixed with rice, is reckoned useful in cases of ophthalmia, and the juice of the fresh bark in 1 oz. doses with an equal quantity of curds is said to be a valuable remedy in dysentery.

Description.—The resin attached to the bark which was collected for us in Canara was very nearly the colour of hock-bottle glass; it was hard, brittle and translucent, and mixed with portions of the corky outer bark of the tree; alcohol readily dissolved it, and on evaporation left it as a very viscous, transparent, light-brown semi-liquid, which did not solidify after many days' exposure to a steam heat; when burnt it gives out a fragrance; the perfume is, however, inferior to that of many other resins employed as incense. The fruit is purplish-brown, of the size of a large nutmeg, slightly 3-angled at the base, mucronate at the apex; it consists of a very thick woody nut, surrounded by an oily shrivelled pulp; within are three cells, each of which contains a sweet-tasted oily flat seed.

Commerce.—The resin as met with in commerce is dark brown or grey in colour, plastic and opaque. It appears to have been obtained by tapping the trees, and is usually very impure. Value, Rs. 24 per cwt.

SAMADERA INDICA, *Gärtn.*

Fig.—*Gärtn. Fruct. II., t.* 156; *Wight, Ill., t.* 68; *Rheede, Hort. Mal. vi., t.* 18.

Hab.—Western Peninsula, Ceylon. The bark.

Vernacular.—Niepa (*Tam.*), Karinghota (*Malabar*), Samadara (*Cing.*).

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Description, Uses, &c.—A tree 30 to 35 feet high, the Karin Njoti of Rheede, who gives Lokhandi as the Brahminic name. It has large, alternate, oblong leaves, and long axillary or terminal peduncles, divided at the top into a small umbel, which becomes pendulous in fruit; the latter is oval, 1½ by 1 inch, and is a dry, compressed, one-seeded drupe, with a narrow unilateral wing; its surface is coriaceous, smooth, or slightly reticulated, and of a brown colour. The seed is brown and curved. The bark (Niepa bark) and the seeds are very bitter; the former is used as a febrifuge on the Malabar Coast. The wood is bitter, of a pale yellow colour like quassia wood, and is prescribed with myrobalans in fever. Sandals made from the wood are supposed to keep off malaria and other diseases, probably from the fact of their protecting the feet and keeping them dry. The natives also extract an oil from the kernels, which is said to be a good application in rheumatism. The bruised leaves are externally applied in erysipelas, and the seeds are worn round the neck as a preventive of asthma and chest affections. (*Rheede.*) This drug may well be used as a substitute for quassia.

The bark from the smaller branches occurs in quills from half an inch to one inch in diameter, its external surface is minutely fissured in every direction, of a dark brown colour, with light coloured patches here and there caused by exfoliation of the suber. Beneath the suber, which can be easily separated, the bark is yellowish-white, and this colour extends through its substance to the inner surface. The bark has a short fibrous fracture and bitter taste like quassia. A transverse section magnified presents no peculiarity worthy of remark.

Chemical composition.—De Vrij (1872) expressed from the seeds 33 per cent. of a light-yellow bitter oil, which contains, according to Oudemans, 84 per cent. of olein and 16 per cent. of palmitin and stearin. The bitter principle, *samaderin*, was yellowish, and soluble in water and alcohol and amorphous; Tonningen (1858) had obtained it from the seed and bark in white scales, which became yellow with nitric or hydrochloric acid, and violet red with sulphuric acid. Flückiger calls it *quassiin*. (*See Year-Book Pharm.*, 1886, p. 196.)

BURSERACEÆ.

BOSWELLIA.

Several species inhabiting Eastern Africa, near Cape Guardafui, Socotra and the Southern Coast of Arabia.

Fig.—*Bentl. and Trim., t.* 58. Frankincense trees (*Eng.*), Arbres d'encens (*Fr.*).

Hab.—Arabia, Socotra, Africa. The gum resin. Olibanum.

Vernacular.—Olibanum, Kundur, Lubán (*Arab., Hind.*), Visesh, Esesh (*Bomb.*), Parangi-shambirani (*Tam., Tel.*).

History, Uses, &c.—For an account of the different species, Birdwood on the Genus Boswellia, with descriptions and figures of three new species [*Linn. Trans.* xxvii. (1871), 111,] and Balfour (*Trans. Roy. Soc. Edin.* Vol. xxxi.,) may be consulted; also the *Pharmacographia*; but the exact number of species cannot be determined until more perfect materials shall have been obtained. An interesting summary of the history of Olibanum in Europe will be found in the *Pharmacographia*. It is the θύος, λιβάνωτός and λίβανος of the Greeks and the Tus or Thus of the Romans.* The olibanum trade between Arabia and India probably dates from pre-historic times. In the Book of Genesis (B. C. 1700), Arab merchants are mentioned as bringing spices, resin and stacte upon their camels from Gilead to Egypt; as no spices are produced in Arabia these must have come from India across the

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* Confer. Theoph. Hist. Plant. iv., 6. ix. 1, 2, 4. Dios. i., 72. Plin. 12. 30, 31, 32. Lucr. 3. 328. From Pliny's account it appears that there was no female frankincense in his time.

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Persian Gulf. Alexander, B. C. 325, found a vessel loaded with frankincense at the mouth of the Indus, and trading companies are mentioned in Yajnavalkya's Code, B. C. 300. The chief centres of trade on the Western Coast were Sopara, Sanjan, Chaul (Perimula), and Thana, where markets appear to have been held during the fair season for the sale of Indian and Chinese merchandise in exchange for that of the West. Trade suffered from the opposition of the Persians and Brahmins in the 6th century B. C., but recovered in the 2nd century B. C., when its course was still from Egypt to Berenike and Aden, round the Arabian Coast to Kurrachi, and *via* Broach to the Thana ports. On the Roman conquest of Egypt, B. C. 30, trade greatly increased by the same route, until in A. D. 47 Hippalus discovered the monsoons and the possibility of crossing direct to the Indian Coast. In Pliny's time the principal exports from India were sesamum, oil, sugar, spices, rice, nard, costus, pepper, lac and indigo, and the imports frankincense, gum, storax, and Yavan girls. (*Sakuntala.*) In A. D. 525, cloves and aloe and sandalwood came from Ceylon, which had then become the chief centre of trade in the East The trade between India and Egypt began to fall off about the close of the 3rd century, and by the 6th century it had almost entirely been transferred to the East African ports. Thana and its ports were still important marts from the 9th to the 13th century, as we learn from the accounts of El Biruni, Ibn Haukal and other Arabian travellers. (*Bombay Gazetteer*) Sanskrit writers speak of olibanum as Kundurú, and describe its use as an incense and as a local application to indolent swellings to promote suppuration. The Mahometan writers describe several kinds of Olibanum—1*st*, deep yellow tears, called Kundur Zakar, or Male Frankincense; 2*nd*, pale tears, called Kundur Unsa, or Female Frankincense; 3*rd*, Kundur Madahraj, artificial tears, made by shaking the moist exudation in a basket; 4*th*, Kishar Kundur or Kashfa, the bark or scurf of the tree coated with the exudation (*Dhup of Bombay market*); 5*th*, Dukak Kundur, or dust of Olibanum. The first kind is most esteemed. Mir Mohammad Husain says that Frankincense should burn readily, showing that it is not mixed with gum Arabic; should not emit much smoke, showing its freedom from Juniper resin. Moreover, he remarks that a kind of Frankincense is said to be produced in India which has a reddish tinge (probably an allusion to the gum resin of *Boswellia serrata*).

Olibanum is considered by the Mahometans to be hot and dry, and to have dessicative, astringent and detergent properties. It is used internally and externally in much the same way as we use the products of the Pines and Firs. In 1868, Olibanum was made official in the Pharmacopœia of India, where it is recommended in chronic pulmonary affections, such as bronchorrhœa and chronic laryngitis, employed both internally and in the form of fumigation. In the same work an ointment has been introduced which is said to be a good stimulant application to carbuncles, ulcerations, boils, &c. A good imitation of commercial Burgundy Pitch may be made by incorporating melted olibanum with water in a steam bath; a sufficiently good quality for this purpose can be purchased for Rs. 12 per cwt. Allcock's porous plaisters are said to be made of it.

Bombay is the centre of the Olibanum trade. The houses which deal in gums have agents in Arabia and Africa, who buy it up and forward it in a mixed condition. It passes through the Custom House as *Esesh* (a corruption of विंरव), and is next sorted into four or five different qualities. The first, consisting of all the large clean tears, is destined for the European market. The intermediate qualities and the last, which is only the dust and refuse, supply the Indian and China requirements. The Kishar Kundur or Kashfa of the Arabs forms a distinct article of commerce under the Indian name of *Dhup*. The method of collecting olibanum in Africa has been described by Cruttenden. (*Trans. Bomb. Geograph. Soc. VII.*, 1846, 121.) Carter in the same publication has described the collection of the drug in Southern Arabia. In both localities a simple incision in the tumid bark is made, and the product collected as soon as it becomes sufficiently hard. The collection is carried on from March to September in Africa, and

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from May to December in Arabia. Balfour found several species of Boswellia growing on Socotra. Of these, *B Ameero* yields an olibanum which on examination by Prof. Dobbie and Dr. Henderson was found to have the same composition as Arabian olibanum. The stalactitic form of olibanum, called Lubán Meyeti, produced by *B. Frereana, Birdw.*, is occasionally met with in the Bombay market under the name of *Pandhri Esesh* or *Pandhri Lubán*; it differs from ordinary olibanum inasmuch as it contains no gum soluble in water.

Examination of some living cuttings of branches of **Boswellia Bhau-Dajiana**, *Birdwood, received from the Victoria Gardens, Bombay, by Mr. J. G. Prebble.*—On wounding the bark a milky fluid immediately exudes. This is faintly acid to litmus paper, and of an agreeable lemon odour and slightly bitter taste. Examination under the microscope shows the milky fluid to be a very fine emulsion of oil; by rubbing it between the cover glass and the slide, the globules of oil may be made to unite in larger drops. Two or three starch granules may be detected in a slide by the aid of the polariscope, but these are probably derived from the neighbouring starch cells and not from the secretory reservoirs. The emulsion is not coloured blue by iodine nor darkened by iron salts. A transverse section shows an outer layer of cork composed of thin-walled, compressed tangentially elongated cells of a yellow colour. It is this layer which is thrown off in thin dry, waxy-looking papery sheets, and hanging loosely about the stem is continually renewed from beneath. Next to the cork is a layer of parenchymatous cells mostly filled with a reddish brown colouring matter associated with tannin. This colouring matter is very little affected by the usual solvents. It is darkened in colour but not removed by solution of potash, but is readily soluble in acetic acid.*

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* Professor J. L. de Lanessan found in the bark of the allied species *Boswellia papyrifera* "une matière colorante rougeâtre insoluble dans l'ammoniaque froid et bouillant, dans une solution bouillante faible d'acide sulphurique, dans l'alcool et l'éther bouillants, légèrement soluble dans l'acide acétique bouillant."—(*Histoire des Drogues, tome* 1—268.)

Cells containing plenorhombic crystals of calcium oxalate are very numerous next the corky layer. Further within the bark are cells containing small oval or oblong starch grains giving a well defined cross with polarized light. The undulating medullary rays, composed of 2 or 3 rows of radially elongated cells, divide the liber into narrow wedges. The large, oval, intercellular secretory reservoirs which contain the milky fluid are mainly distributed in this layer in three or four interrupted and not very regular tangential rows. The lumen has an average measurement of 100 mkm., and is surrounded by two or three rows of secreting cells. A few secreting reservoirs occur in the outer bark, but they are not met with in the wood nor in the medulla.

Interspersed through the bark and sometimes forming an interrupted ring in the outer bark, are groups of refractive bast fibres. The wood is composed of narrow wedges of woody parenchyma containing numerous vessels. The medulla contains like the bark a reddish brown colouring matter blackened by iron salts. In longitudinal section the secretory reservoirs anastomise in a peculiar manner like the links in a chain, and the bast fibres frequently bifurcate. The medullary rays are composed of two or three rows of cells from six to twenty deep and not arranged in parallel rows

According to the account of the Swiss traveller, G. A. Haggenmacher,* the bark is used by the Somalis for tanning. Assayed for tannin by Löwenthal's permanganate and gelatine process, and observing the details recommended by H. R. Proctor; 4·7 c. c. permanganate solution, 1 gramme per litre, was consumed by 20 c. c. of a decoction representing ·2 gramme of dry bark. Expressed in terms of oak bark using Oser's equivalent, these results give 4·7 per cent tannin extracted by boiling water.

Description.—Olibanum as found in commerce varies considerably in quality and appearance. It may be described as a dry gum-resin, consisting of detached tears up to an inch in length, of globular, pear-shaped, clavate, or stalactitic form, mixed with more or less irregular lumps of the same size. Some of the longer tears are slightly agglutinated, but most are distinct. The predominant forms are rounded—angular fragments being less frequent, though the tears are not seldom fissured. Small pieces of the translucent brown papery bark are often found adhering to the flat pieces. The colour of the drug is pale yellowish or brownish, but the finer qualities consist of tears which are nearly colourless or have a greenish hue. The smallest grains only are transparent, the rest are translucent and somewhat milky, and not transparent even after the removal of the white dust with which they are always covered, but if heated to about 94° C., they become almost transparent. When broken they exhibit a rather dull and waxy surface. Examined under the polarizing microscope, no trace of crystallization is observable. Olibanum softens in the mouth; its taste is terebinthinous and slightly bitter, but by no means disagreeable. Its odour is pleasantly aromatic, but is only fully developed when the gum resin is exposed to an elevated temperature. At 100° C. the latter softens without actually fusing, and if the heat be further raised decomposition begins. (*Pharmacographia.*)

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* Quoted by Flückiger, *Pharm. Journ.* [3] viii. 807.

Chemical composition.—Flückiger and Hanbury observe that cold water quickly changes olibanum into a soft whitish pulp, which when rubbed down in a mortar forms an emulsion. Immersed in spirit of wine, a tear of olibanum is not altered much in form, but it becomes of an almost pure opaque white. In the first case the water dissolves the gum, while in the second the alcohol removes the resin. They find that pure olibanum treated with spirit of wine leaves 27—35 per cent. of gum, the solution of which is precipitated by perchloride of iron as well as by silicate of sodium, but not by neutral acetate of lead. It is consequently a gum of the same class as gum Arabic, if not identical with it. Its solution contains the same amount of lime as gum Arabic affords. The resin of olibanum has been examined by Hlasiwetz (1867), according to whom it is a uniform substance having the composition $C^{20} H^{30} O^{3}$

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Flückiger and Hanbury find that it is not soluble in alkalis, nor have they succeeded in converting it into a crystalline body by the action of dilute alcohol. It is not uniformly distributed throughout the tears; if they are broken after having been acted upon by dilute alcohol, it now and then happens that a clear stratification is perceptible, showing a concentric arrangement. Olibanum contains from 5—7 per cent. of essential oil. According to Stenhouse it has a sp. gr. of 0·866, a boiling point of 179·4 C., and an odour resembling that of turpentine but more agreeable. Kurbatow separated this oil into two portions, one of which has the formula $C^{10} H^{16}$, boils at 158° C., and combines with HCl to form artificial camphor; the other contains oxygen.

Luban Meyeti, which is is considered by Flückiger and Hanbury as the *Oriental* or *African Elemi* of the older writers, and also one of the resins anciently designated *Animi*, has an agreeable odour of lemon and turpentine, and a mild terebinthinate taste. Treated with spirit of wine, ·838 of it is dissolved; the undissolved portion is not crystalline. Distilled with water it yields about 3 per cent. of a fragrant volatile oil having the odour of elemi, and a sp. gr. of ·856 at 16° C. The oil examined in a column 50 millim. long, deviates the ray 2°·5 to the left. It consists of a dextrogyre hydrocarbon, $C^{10}H^{16}$, mixed with an oxygenated oil, which is evidently levogyre, and exists in proportion more than sufficient to overcome the weak dextrogyre power of the hydrocarbon. No gum is present in this exudation. (*Pharmacographia.*)

Commerce.—Olibanum is shipped from Makulla, Aden, and other neighbouring ports to Bombay; as already mentioned, it is there sorted for the different markets. The trade is in the hands of Khojas and Banias. The price varies from Rs. 4 per cwt. for the dust to Rs. 20 per cwt. for the finest tears. Bombay exports from 25,000 to 30,000 cwts. annually. Nearly four-fifths of this quantity go to Europe, and the rest to China.

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BOSWELLIA SERRATA, *Roxb.*

Fig.—*Colebr. in Asiat. Res. IX.*, 379, *t.* 5. Salai tree, (*Eng.*).

Hab.—W. Himalaya, Central India. The gum-resin.

Vernacular.—(The gum-resin) Salai, Gúgal (*Hind.*), Gugar (*Guz.*). In Southern India it bears the same names as olibanum.

History, Uses, &c.—The history of this drug is involved in much obscurity, owing to it shaving been confounded by both native and European writers with true Frankincense and Bdellium. Sanskrit writers may possibly sometimes allude to it when they speak of Kunduru, but as this word is evidently the same as the Arabic Kundur, it is much more likely that they allude to the true Frankincense imported from Africa and Arabia, and which we know to have been introduced into India at a very remote period. Mahometan writers have probably included the produce of *B. serrata* among the different kinds of Mukul for which they give as the Indian synonym Gúggul. It seems probable that the true Sanskrit name for *B. serrata* is Sallaki, from which the Hindi word Salai has been derived. The exudation from the tree is called Sallaki-drava or Sihla, and Guggulu. Ainslie notices *B. glabra* as producing Gúggul, and *B. serrata* the olibanum of commerce, but calls the latter *Salai*, and quotes Dr. F. Hamilton's MS. account of Shahabad, where the tree is said to be very common and to yield a resin called *Sale-gond* or *Sale-lassa, which is not used*. Dr. Hamilton describes it as of the consistence of turpentine when it flows from the tree; in this state it is called at Chandalghar Gandah-biroza, and in the dry state Sukha-biroza. (*Mat. Ind.* 1, 226.) Other European authors make the same mistake with regard to the source of commercial olibanum. *B. glabra* is now considered to be only a variety of *B. serrata*. *B. serrata* is one of the commonest trees in some parts of Khandesh, Loonawara, and other neighbouring territories; the gum-resin is obtained by incising the bark. Dr. Hooker, when ascending from Belcuppee in Behar to the height of 1,360 feet, came upon a small forest of these trees, which he likens to the mountain ash. Dr. Irvine remarks that the tree is very plentiful in the Ajmeer hills, where the gum-resin is called Ganda-biroza, and is similar in appearance to Venice turpentine. Dr. O'Shaughnessy obtained fine specimens from the Shahabad country. The collection of Gúggul is a source of revenue to the Bhils, and a stake cut from the tree is set in the ground when a marriage takes place among them. Sanskrit writers describe Guggulu as moist, viscid, fragrant, and of a golden colour when freshly exuded—a description which is not applicable to the exudation of the Balsamodendrons, but is exactly so to the exudation of *B. serrata*. It is said to be demulcent, aperient, alterative, and a purifier of the blood. The Yogarája gúggula is a well known alterative compound; it contains Guggal 25 parts, Triphala 15 parts, ginger, long pepper, chavak, pipalimul, chitrak, hing, ajmod, siras, jira, shahjira, renuka, indrajao, paharmul, baberang, kutki, atis, bharingi, vekhand, of each one part, morvel two parts. The whole is made into a pill mass, the dose of which is from 3 to 5 grains, to be taken with a decoction of *Sphæranthus indicus*. It is used in rheumatism, nervous diseases, scrofulous affections, urinary disorders and skin diseases, and is generally combined with aromatics.

Description.—The fresh exudation has the colour and consistence of Canada Balsam; it hardens very slowly, retaining its golden colour and transparency. The odour is that of olibanum, but fainter and more terebinthinate; cold water converts it into a soft whitish pulp, which, when rubbed in a mortar, forms an emulsion. Spirit also makes it white and opaque by dissolving the resin. In short, it has the characters of olibanum, but does not harden like that article. It burns readily, and diffuses an agreeable odour.

Commerce.—Gúggal is not exported from India, but is consumed in Central and Northern India as an incense and medicine.

A large quantity is collected in the Satpoora forests, where it is sold on the spot at 12 lbs. for a rupee.

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BALSAMODENDRON, *Sp. var.*

Fig.—*Bentl. and Trim., t.* 60.

Hab.—Africa, Socotra, Arabia. Myrrh.

Vernacular.—Bol (*Hind., Beng., Guz.*), Vellaip-polam (*Tam.*), Bálimtra-polam (*Tel.*), Bolá (*Can.*), Bálata-bola (*Mar.*).

History, Uses, &c.—Myrrh was known to the ancient Egyptians, Professor Dümichen has discovered an inscription at Deir el Bahari which records an expedition to the balsam land of *Punt* (the modern Somali country), undertaken by Hatasu, a queen of the XVIIIth dynasty, who lived about 1700 years B. C. Through this expedition, we learn from the inscriptions, "thirty-one verdant myrrh trees" were introduced into Egypt, besides a large quantity of myrrh. In a drawing on the walls of Hatasu's temple at Deir el Bahari there is a reprsentation of myrrh trees planted in wooden tubs and heaps of myrrh, which are recorded as having been "brought over the ocean to Egypt." The inscriptions which refer to these trees give very exactly the place from whence they came. They were, we are told, "brought over the sea in ships from the incense mountains of the Somali country." These mountains, we are further told, formed the "best district of the incense-land." In another drawing on the Deir el Bahari monument, may be seen a figure of one of these trees. It represents a medium size tree with somewhat thick trunk and spreading branches. The leaves are oval, and appear to terminate in an acute point. There is also shown, exuding from the stem in the form of tears, a gum-resin, which in the original is coloured red. Myrrh was also imported into Egypt from Socotra. An inscription on the walls of Thothmes III.'s temple at Karnak, erected about 1600 B. C., records an expedition undertaken by that king to this island, for the purpose, it is related, of introducing "all the beautiful plants of that country." Many of the plants are figured on the walls of the Karnak temple, and among them is undoubtedly one which represents the myrrh tree. Myrrh was also imported from Arabia, as is shown from a sentence in the Papyrus

Harris written in the time of Rameses the III., about 1250 B. C., and several inscriptions of a later date. (*Newberry in Pharm. Journ., Nov.* 17, 1888.) Myrrh is not much used by the Hindus. It is called Vola in Sanskrit, a word which appears to be the same as the Greek βωλος and the English Bole, signifying a lump of earth or clay. It is described as useful in fever, epilepsy, and uterine affections, and is given to women for eleven days after confinement mixed with molasses to purify the womb. The similarity of its properties to those of Bdellium, which is an article of importance in Hindu medicine, probably accounts for its not having greatly attracted the attention of the Hindus upon its introduction into India from the West. The Greeks and Romans used it to flavour their wine; they also anointed their hair with a perfumed unguent made from it: "lautissima apud priscos vina erant, myrrhæ odore condita." *Plin.* 14, 15; "crines myrrha madidi," *Ovid. M.* 10, 298, *et seq.* It is the σμυρνα of Dioscorides, I., 69. According to a Greek myth, Myrrha, ashamed of her incest with her father Cinyrus, begged the gods to change her into some object neither dead or alive: she became the Myrrh tree. With the Mahometans Myrrh is an important article of the Materia Medica. They describe the tree which produces it as tall and handsome, with knotted branches, a native of Socotra and neighbouring countries, and say that spears are made of the branches, which are solid and free from pith; that the juice when it first exudes is white and milky, and that the best Myrrh is obtained by making incisions in the tree. What exudes of itself is called Batárch.* After the trees have been wounded, mats and vessels are placed to catch the juice. Balfour found several species of Balsamodendron growing in Socotra, one of which was a tree 30 feet high and very fragrant, but he did not obtain any of the gum-resin. This plant is named by him *B. socotranum*, and has points of resemblance with *B. Myrrha, Nees*, a myrrh-bearing tree of Somali land. According to Mir Mohammad Husain the best Myrrh should be of a reddish yellow colour, and the surface covered with a pale dust. When broken it

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should show white marks like those at the root of the finger nail. The same authority says that Myrrh is hot and dry; detergent, siccative, astringent and aperient, a disperser of cold tumours, and one of the most important of medicines, as it preserves the humours from corruption. It is much used externally as a stimulant and disinfectant application to ulcers, sores, &c. Dissolved in women's or asses' milk it is dropped into the eye in purulent ophthalmia. As an internal remedy it is given in coughs, in atonic dyspepsia, diarrhœa, amenorrhœa, worms, &c. It is also thought to keep away fever, and prevent the hair falling off. Administered by means of fumigation it is said to have the same effect as when taken in the ordinary way. The leaves, fruit, and wood are said to partake of the same properties as the gum-resin. The history of the use of Myrrh in Europe goes back to a very early date. A good summary will be found in the *Pharmacographia.* Bombay is the centre of the Myrrh trade. The merchants who deal in the gums which come from the north-east of Africa and Southern Arabia, have their chief houses here, and employ partners or agents at Aden and Makalla; the Aden agents also attend the great annual fair at Berbera on the opposite coast, and exchange English and Indian goods for Myrrh, Bdellium and other African produce. The bags or bales which contain the Myrrh, when opened in Bombay, are found to be made up of—1*st*, a large proportion of roundish masses of fine Myrrh; 2*nd*, a considerable proportion of small semi-transparent pieces of Myrrh of irregular shape; 3*rd*, numerous pieces of dark-coloured Myrrh, mixed with bark and other refuse; 4*th*, a small proportion of an opaque gum-resin (Bdellium opaque of Guibourt), occasionally pieces of resin (juniper?) are also met with. In Bombay the contents of the package are sorted; the best Myrrh goes to Europe; the darker pieces form a second quality, and the refuse is exported to China, where it is said to be used as an incense. True Myrrh is known in the Bombay market as *Karam* or *Bandar Karam.** From Makalla and Aden another kind of Myrrh is received, Arabian Myrrh. The trade name of this

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* A seaport on the African coast nearly opposite Aden.

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drug in Bombay is Meetiya; it is mostly sold in India as true Myrrh, for which it might easily be mistaken by any one not specially acquainted with drugs. The dealers here say that no true Myrrh is ever received from Arabia. A kind of myrrh resembling Meetiya is sometimes sold in Bombay as Chenai-bol or "Chinese myrrh," and it is curious that Ibn Batuta (1340) amongst the articles of trade at Thana, mentions musk and myrrh from China. Persian Myrrh has only recently made its appearance in the market; it occurs in very large masses of a rich reddish brown colour and considerable translucency; very oily; in taste and odour it resembles African Myrrh very closely. Pieces of papery bark are found adhering to it. It comes principally from Mekran, and is probably the Myrrh mentioned by Arrian as having been found by Alexander's army in the country of the Γαδρωσοί. It readily forms an emulsion with water, and appears to have all the properties of commercial Myrrh.* The botany of the Myrrh trees is still encompassed with uncertainty, which cannot be removed until the very localities in which the drug is collected shall have been explored by a competent observer. At present all we can say is that it is probable that Ehrenberg's or Carter's Balsamodendron produces the Arabian Myrrh, and that a much larger species, probably *B. Myrrha, Nees.*, growing in north-eastern Africa, produces the true Myrrh of commerce. It seems probable also that Balfour's *B. socotranum* is a myrrh tree. Of the source of the Persian Myrrh we know nothing as yet.

Description.—Myrrh consists of irregular roundish masses varying in size from small grains up to pieces as large as an egg, and occasionally much larger. They are of an opaque reddish brown, with dusty dull surface. When broken they exhibit a rough or waxy fracture, having a moist and unctuous appearance, especially when pressed, and a rich brown hue. The fractured translucent surface often displays characteristic whitish marks which the ancients compared to the light marks at the base of the finger nails. Myrrh has a peculiar and

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* In 1882 the imports of Persian Myrrh rose to 1,000 cwts.

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agreeable fragrance, with an aromatic bitter and acrid taste. Water disintegrates it, forming a light brown emulsion which, viewed under the microscope, appears made up of colourless drops, among which are granules of yellow resin. Alcohol dissolves the resin of Myrrh, leaving angular non-crystalline particles of gum and fragments of bark. (*Pharmacographia.*)

Chemical composition.—Flückiger and Hanbury say:—"The gum which is dissolved when Myrrh is treated with water amounts to between 40 to 50 per cent. It is partially precipitable by neutral acetate of lead, showing that it differs from gum Arabic; but a portion (about one-fourth) agrees with the latter in respect to its action on acetate of lead. The resin dissolves completely in chloroform or alcohol, and the colour of the latter solution is but slightly darkened by perchloride of iron.* It is but partially soluble in alkalis or in bisulphide of carbon. Brückner (1867) found this portion to yield 75·6 per cent. of carbon and 9·5 of hydrogen. The resin which the bisulphide refuses to dissolve is freely soluble in ether. It contains only 57·4 per cent. of carbon. The resin of Myrrh to which when moistened with alcohol a small quantity of hydrochloric acid is added, assumes a violet hue, but far less brilliant than that displayed by resin of Galbanum when treated in a similar manner. Myrrh yields on distillation a volatile oil, which in operating on 25 lbs. of the drug, we obtained to the extent of $\frac{3}{4}$ per cent.† It is a yellowish, rather viscid liquid, neutral to litmus, having a powerful odour of Myrrh and sp. gr. 0·988 at 13° C. In a column 50 mm. long, it deviates a ray of light 30·1° to the left. By submitting it to distillation, we obtained before the oil boiled, a few drops of strongly acid liquid having the smell of formic acid. Neutralized with ammonia, this liquid produced in solution of mercurous nitrate a whitish precipitate, which speedily darkened, thus indicating formic acid, which is developed in the oil. Old Myrrh is in fact said to yield an acid distillate. The oil begins to boil at about 266° C., and chiefly distils over between 270° and 290°.

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* The proportion of resin in Myrrh is variable, Flückiger has found the finest samples to yield as much as 27 per cent.

† Distilled on a large scale, good Myrrh yields as much as 4·4 per cent.

"On combustion in the usual way it afforded carbon 84·70, hydrogen 9·98. Having been again rectified in a current of dry carbonic acid, it had a boiling point of 262 to 263° C., and now afforded carbon 84·70, hydrogen 10·26, which would nearly answer to the formula $C^{22} H^{32} O$. The results of Ruickhold's Analysis (1845) of essential oil of Myrrh assign it the formula $C^{10} H^{14} O$, which is the same as that of carvol and thymol, and widely different from that indicated by our experiments. The oil which we rectified displays a faintly greenish hue; it is miscible in every proportion with bisulphide of carbon, the solution exhibiting at first no peculiar colouration when a drop of nitric or sulphuric acid is added. Yet the mixture to which nitric acid (1·20) has been added, assumes after an hour or two a fine violet hue, which is very persistent, enduring even if the liquid is allowed to dry up in a large capsule. If to the crude oil dissolved in bisulphide of carbon bromine be added, a violet hue is produced, and if the solution is allowed to evaporate, and the residue diluted with spirit of wine, it assumes a fine blue, which disappears on addition of an alkali. The oil is not altered by boiling with alcoholic potash, nor does it combine with alkaline bisulphites.

"The bitter principle of Myrrh is contained in the resin as extracted by alcohol. By exhausting the resin with warm water an acid brown solution is obtained; from which a dark, viscid, neutral mass separates if the liquid is concentrated; it is contaminated with a large amount of inorganic matter, from which it may be purified by means of ether. Yet the latter affords also but an amorphous, somewhat brittle brown substance, softening at 80°—90° C. This bitter principle is but sparingly soluble in water, and the yellowish solution is intensely bitter. The bitter principle of Myrrh appears to be a glucoside."

Commerce.—The sources of supply have been already noticed. Value, Bander Karam, Rs. 34 per maund of 37½ lbs.; Meetiya, Rs. 16 to 25 per maund; refuse, Rs. 8 per maund.

Other allied Gum-Resins.—From Berbera also comes *Bdellium* (*Vern.* Mhaisábol, or Bysabol[*]). In the bales of this drug two distinct kinds are met with, *viz.*, ordinary Bdellium, which to a certain extent resembles Myrrh, but is of a darker colour, less oily, and has a peculiar odour destitute of the aroma of Myrrh, and a perfumed kind called by the Arabs *Habak-Hadee*,[†] which occurs in irregular-shaped pieces more or less flat, some of them having earth and fragments of bark adhering; it is of a dark reddish brown colour, but opaque yellowish white streaks run through the semi-transparent reddish mass. The odour is more powerful and more perfumed than that of common Bdellium; the taste perfumed, aromatic, and feebly bitter, whereas common Bdellium is strongly bitter and has hardly any aroma. *Indian Bdellium* (*Mhaisagúggal*), *the produce of B. Mukul*, somewhat resembles the African drug in general appearance, the pieces often having portions of papery bark attached to them, but the colour is lighter, often greenish; the odour and taste are somewhat different, and a certain proportion of it is in distinct vermiform pieces as thick as the little finger. Its value is one-third less than that of African Bdellium. *Opaque Bdellium* is found in small quantities in the packages of Myrrh and other gums which come from Africa. It is known in Bombay as *Meenaharma*, and is of a yellowish white colour; and quite opaque like ammoniacum [‡]; it has hardly any odour, but a very bitter taste. The native practitioners use it to facilitate the extraction of Guinea-worms; it would appear to poison the animal, as it makes it loosen its hold upon the tissues. *Indian Bdellium* (*Mhaisagúggal*), *the*

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[*] Buffalo Myrrh, because it is given to these animals to increase the flow of milk, from the Sanskrit Mahisha, a buffalo, and Vola, myrrh. It is also called in Sanskrit Saindhava or Samudriya gúggula, as coming from beyond the sea.

Dioscorides (i., 71,) mentions three kinds of *βδελλίον*. Indian Bdellium he says, is dirty and dark-coloured, and is called *ἁδρόβωλον*, i.e., *sticky bole*. Arabian Bdellium is described as dry, resinous and bluish or greenish black. His third kind is probably a kind of Myrrh.

[†] Pliny 12, 35, mentions an odoriferous myrrh.

[‡] It is perhaps the white myrrh of Pliny, 12, 35.

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produce of B. Roxburghii, occurs in irregular lumps, covered more or less with dirt and hair, to which portions of papery bark as well as the thick inner bark sometimes adhere; it is of a greenish yellow colour, with an occasional tinge of red; consistence waxy, soft, and brittle; odour peculiar and balsamic, something like cedarwood; taste bitter. With water it forms a greyish-white emulsion; when inflamed it swells and sputters instead of burning with a clear flame like the Gúggal of *Boswellia serrata.* We have been favoured by Mr. Woodrow with fresh specimens of the stem and exudation of *B. Roxburghii* collected near Peit, about 30 miles north of Poona, where the tree has been planted to form a hedge round a Hindu temple.

Description.—The epidermis of *Balsamodendron Roxburghii* consists of several rows of delicate elongated cells, containing a little granular matter; the cells beneath this, which form the green bark, are loaded with chlorophyll and starch. Proceeding inwards the chlorophyll gradually diminishes, and a few bundles of liber cells are met with, forming a broken irregular zone. Within this the cells contain granular matter, starch, and globules of balsam; balsam ducts permeate the bark at intervals, and the medullary rays are distinctly traceable; a few conglomerate raphides are met with. The wood, which is white, soft and brittle, consists of elongated thin walled cells divided into zones; in the zone next the bark the cells (18 to 20 rows) are empty, or contain a little starch; in the next they are smaller and loaded with large starch granules. The same kind of structure is continued to the central pith, which consists of cells of starch. The exudation of this tree as cultivated at Peit is at first opaque and milky; as it dries it becomes greenish and translucent, and finally solidifies. Mahometan writers describe the different kinds of Bdellium under the name of *Mukul,* and say that it is the produce of a large tree common in Arabia and the neighbouring countries, and also in India. They distinguish several kinds, all of which are bitter. That having a reddish tinge they call *Mukul-i-azrak*; the yellowish, *Mukul-i-*

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yahud; the brown, *Sakalabi*; and the rich reddish brown, *Mukul-i-Arabi*. Good Bdellium should be clean, bright, sticky, soft, sweet-smelling, yellowish, and bitter; when burnt it smells like Bay; it mixes readily with water, and is described as hot and dry; from the account of its properties in the Makhzan-el-Adwiya, it would appear to be used in very nearly the same way as myrrh. The cheaper kinds of Bdellium are largely used to give adhesiveness and polish to the fine plaster used by masons upon the ceilings and pillars of houses.; for this purpose the gum is dissolved, strained, and mixed with molasses. Indian Bdellium combined with Black pepper and Colchicum has a reputation in muscular rheumatism; it is given internally, and also applied to the painful part as a *lép*.

Chemical composition.—Flückiger remarks that Bdellium differs from myrrh in its stronger, almost acrid taste and in odour; it contains very little resin; this resin is different from that of myrrh, being paler and redder; it is very sparingly soluble in bisulphide of carbon; this solution is not altered by bromine, whilst that of true myrrh resin assumes a most intense violet colour; it is not soluble in petroleum ether. Of the gummy substance, which is by far the prevailing constituent of this drug, a small portion only is soluble in water. Parker has examined opaque bdellium with the following result:—"*Opaque Bdellium* (*Balsamodendron Playfairii*) is a very hard, yellow ochre-coloured, opaque gum-resin, with but slight odour and a bitter taste. In common with other exudations from the genera *Balsamodendron* and *Boswellia*, tears of this substance frequently have portions of papery bark attached to their surface. Triturated with water, opaque bdellium forms a very good cream-coloured emulsion. Cold absolute alcohol dissolves about 50 per cent.; the residue is not entirely soluble in water, the soluble portion swelling up and giving the characters of bassorin.

"The colouring matter appears to be due to a resin very soluble in alcohol, giving a canary-yellow coloured tincture; this resin is also soluble in ether, benzol and chloroform. The tincture (1 of gum-resin to 6 of rectified spirit) becomes

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slightly milky with alcoholic solution of plumbic acetate, gives a slight yellow precipitate with one drop of liq. plumbi subacet., and an intense greenish-black colour with tinct. ferri perchlor. It is bitter and becomes milky with water.

"The mucilage made by dissolving 1 part of the gum (completely washed with rectified spirit) in 40 of water, is tasteless, partly precipitated by subacetate of lead and not at all by neutral acetate.

"The ash (1·6 per cent.) appears to be chiefly calcic carbonate, dissolving entirely with effervescence in dilute acetic acid, and giving a copious precipitate with ammonium oxalate.

"Water distilled from opaque bdellium had the slight odour of the drug, but there was no appearance of oil globules in working on a small scale.

"Composition of opaque bdellium—

Soluble in alcohol (by difference)	47·42
Gum soluble in water	30·01
Gum insoluble in water	11·07
Moisture...	11·50
	100·00."

—*Pharm. Journ., July 17th,* 1880.

Commerce.—The source of African Bdellium has already been noticed.* Indian Bdellium is produced in the Central Provinces, Cutch and Sind. Value, African, Rs. 8 per maund of 37½ lbs.; Indian, Rs. 3⅜ to Rs. 4 per maund.

B. pubescens (Bayee. of the hill Beloochees) yields a small quantity of a tasteless, inodorous, brittle gum almost entirely soluble in water, which is not an article of commerce, *cf.* Stocks in *Phar. Journal* (i.), Vol. IX., p. 275), where figures of *B. Mukul* and *B. pubescens* will be found. Combined with sulphur, catechu and borax it has been recommended by

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* The plant, which is now growing at Kew, and was brought home by Mr. Wykeham Perry as the Bysabol plant, and which was identified by Bentley and Trimen in 'Medicinal Plants' as *Hemprichia erythræa*, has been identified by Professor Engler, as the var. *glabrescens* of that plant.

Dr. J. Newton as a stimulating application to Delhi boils, to promote healthy granulation.

B. Berryi, *Arn.*, *Bedd. Fl. Sylv. t.* 126, yields a gum-resin which affords 84 per cent. of a good adhesive gum allied to arabin, and a soft, white, neutral, tasteless, and odourless oleo-resin soluble in alcohol, ether and chloroform. The resin does not give the same colour reactions with bromine and with concentrated hydrochloric acid as that of the true myrrh.

BALSAMODENDRON PLAYFAIRII, *Hook. f.*

Hab.—Arabia, North Africa.

Vernacular.—Hotai (*Somali*), Dukh (*Indian name in Muscat*), Dijj (*Arabic*).

History, Uses, &c.—This is the name of a gum-resin produced by a small thorny tree which grows in the Somali country about Bunder Murrayah; the shrub is described as about six feet high, and not unlike the Myrrh. The gum-resin is used by the Somali women as a detersive for the hair. Dr. Jayakar of Muscat informs us that it is principally used by the Arabs in Oman for washing clothes: a small piece is tied in a rag and allowed to soak in the water for a few minutes, when it is placed in the clothes to be washed and well beaten with a piece of wood. It is also used for washing the body; for this purpose a piece is soaked in water and well stirred, so as to produce a froth like soapsuds upon the surface; the froth is then rubbed over the skin. Dijj is also an ingredient in a *Hibar* (plaster) used in cases of local injuries, particularly those of the chest, also in rheumatic affections. Internally it is administered as an expectorant and is an ingredient of a suppository for piles.

The method of administering Dijj internally consists in taking a small piece of it, about half the size of an ordinary marble, and rolling it in a small piece of peeled lime fruit; it is then swallowed. This dose is given twice or thrice daily. (*Jayakar.*) According to the Arab lexicographers, the name

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of this gum is دجاج Dijaj or Dajjáj, and it is described under that name in the Makhzan-el-Adwiya as a gum like olibanum brought from the mountains of Oman, which is better than soap for washing clothes, as it makes them whiter; it is also said to be a useful application to wounds to remove proud flesh and promote healing; when made into a paste with honey it is applied to chronic rheumatic swellings of the limbs. (*Op. cit., article Dajjáj.*) Vaughan sent a sample of Hotai from Aden to Hanbury, who gives the following description of it:—

"Irregular pieces 1½—1 inch in their longest diameter, frequently rounded on one side, as if portions of large tears, of entire smaller tears, and of irregular little fragments produced by the fracture of the masses. It is of wax-like opacity, cracked in all directions, and readily breaking up into angular, pieces; on the exterior the larger pieces are yellowish-brown or somewhat liver-coloured, and occasionally encrusted on one side with a reddish sand, upon which they appear to have fallen when in a soft state; internally the colours are generally paler or nearly white, sometimes darker towards the centre of the tear. The gum is nearly inodorous, but in taste is slightly bitter and acrid to the throat. A few fragments agitated with water in a phial speedily afford an emulsion, which remains frothy and milky for many days."

Bentley and Trimen have suggested that Hotai may be the same as Opaque Bdellium, but Parker (*Pharm. Jour., July 17th*, 1880,) has pointed out that tincture of the latter gum-resin gives an intense greenish-black colour with tincture of perchloride of iron, whereas gum Hotai gives no such reaction.

BALSAMODENDRON OPOBALSAMUM, *Kunth.*

Fig.—*Bentl. & Trim., t.* 59. Balsam tree (*Eng.*), Balsamier de la Mecque (*Fr.*).

Hab.—Arabia. The balsam, wood, and fruit.

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Vernacular.—The balsam, Balasán (*Arab.*, *Pers.*, *Ind*); the fruit, Hab-el-Balasán (*Arab.*, *Ind.*), Tukm-i-Balasán (*Pers.*); the wood, Ud-i-Balasán (*Pers.*, *Ind.*).

History, Uses, &c.—This is the βαλσάμον of the Greeks, (Dios. i., 18; Theophr. H. P. IX. 1, 2, 6, 7,) and the Balsamum of the Romans (Plin. 12, 54). Dioscorides also notices the use of the fruit (*carpobalsamum*) and wood (*xylobalsamum*). Arabic and Persian writers describe the Balsam tree as having hoary leaves like rue, and say that it is affected by heat and cold, drought and moisture, like a human being. They affirm that it sprang from the blood of the slain in Mahomet's conflict with the tribe of Harb, and that the Prophet used the Balsam for the resuscitation of the dead. Sheik Dawood of Antioch says that the Christians have a tradition to the effect that when the Holy Virgin Mary and our Lord fled to Matriya in Egypt, our Lord washed His clothes at a well, and from the waste water which ran upon the ground, the Balsam tree sprang up, that on this account the tree is held in great veneration by the Christians, who value the Balsam at its weight in gold. The wood is called Ud-i-balasán; it is heavy and red, with yellowish bark. Genuine Balasán when thrown into water sinks; cotton dipped in it can be washed quite clean in water; when rubbed upon a stick and inflamed it should burn without injuring the wood, like naphtha. (*Makhzan-el-Adwiya, article Balasán.*) Abd-el-Latif, who lived from 1161 to 1231, has described the extraction of the Balsam at the garden of Matriya near Cairo. He says that incisions are made with a sharp stone through the bark down to the wood, the juice is scraped from the tree by the fingers,* and preserved in bottles which are buried in the earth for a time, and afterward exposed to the sun until all the Balsam has separated from the impurities; it is then subjected to some secret process after which it is stored in the king's treasury. The annual produce of the garden is about 20 ratls. (*Husn-el-muhâsarin fi akhbár Misr wa el Kahirah.*) The Balsam is also extracted

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* Theophrastus says ονυξι σίδηροις.

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by boiling the leaves and wood in water. P. Bellonius (*Obs. Lib.* II., cap. 39 and 40) describes a visit to the Matriya gardens for the purpose of seeing the Balsam trees in A.D. 1547.

Description.—Balsam of Mecca, when freshly imported into Bombay, is a greenish turbid fluid of syrupy consistence having a very grateful odour, something like oil of rosemary, when dropped into a vessel containing water it rises and forms a thin film upon the surface of the liquid, which after about a quarter of an hour can be raised entire by touching it with a pencil. When rubbed upon the palm of the hand for a few minutes, it loses its essential oil and becomes very sticky; dissolved in six parts of alcohol 60 O. P. it forms a turbid greenish solution with many opaque flakes floating in it; these are soon deposited and adhere to the bottom of the bottle. The alcohol solution dropped on paper and placed in the sun rapidly evaporates, leaving a slightly sticky varnish upon the surface of the paper. The Balsam itself dropped upon common scribbling paper spreads a little and soon becomes very thick; the paper beneath the drop becomes translucent only; after 12 hours it becomes so hard that when touched it no longer adheres to the finger.

Treated with six parts strong sulphuric acid, the Balsam forms a rich red brown translucent solution of the colour and consistence of Stockholm tar, which upon being poured into water throws down a dull brown resinous deposit. Balsam of Mecca, which has been kept some time in the shops, becomes yellowish and more viscid; the essential oil would appear to be very volatile, as after a short exposure the Balsam does not render paper translucent, and has a simply terebinthinate odour. The taste is aromatic, bitter, and somewhat acrid. It would thus appear that the balsam imported into India is very nearly of the same character as that described by Guibourt and supplied to him by M. Delessert, only that being fresher it differs in colour and contains more essential oil.

Chemical composition.—Trommsdorff found in a sample of this Balsam 30 per cent. of volatile oil, 64 per cent. of hard resin, 4 per cent. of soft resin, and 0·4 per cent. of bitter principles. The volatile oil was mobile, colourless, fragrant and had a rough taste; it dissolved in alcohol and ether, and with a deep red colour in sulphuric acid, whence it was precipitated by water as a resin. It was also resinised by nitric acid. The hard resin was honey yellow, transparent, brittle, of specific gravity 1·333, softened at 44° C., and melted completely at 90° C. It dissolved with difficulty in alcohol and ether at ordinary temperatures, easily with aid of heat; it was likewise soluble in oils, both fixed and volatile. It was altered by hot nitric and sulphuric acids, and appeared to combine with alkalies, forming compounds insoluble in free alkali. The soft resin was brown and very glutinous, inodorous and tasteless; melted when dry at 112° C. It was insoluble in alcohol and ether, but soluble in oils, both fixed and volatile. It was not attacked by alkalies or by strong sulphuric acid; with nitric acid, it swelled up and became friable.

Hab-el-Balasán.—The fruit is imported from Arabia and is kept by all the native druggists who deal in what are called in India "Mughlai" or "Yunani" medicines; it has a pleasant terebinthinate odour, and exactly corresponds with the figures and description of the fruits of *B. Opobalsamum* in Bentley and Trimen's "Medicinal Plants." If soaked in water they soften and can be easily dissected, and the remarkable form of the pulpy layer within the epicarp be seen. Sections of the epicarp show very large ramifying balsam cells, which appear to communicate one with another. The fruit is considered to be a powerful carminative and digestive; it is also praised as a stimulant expectorant, and is usually administered in combination with tragacanth.

Commerce.—Balm of Mecca, Rs. 8 per lb.; the fruit, Re. ½ per lb.

GARUGA PINNATA, *Roxb.*

Fig.—*Roxb., Cor. Pl. iii., t.* 208; *Rheede, Hort. Mal. iv., t.* 33.

Hab.—India. The fruit and juice.

Vernacular.—Ghogar, Kharpat (*Hind.*), Kankar, Kurak, Kusar (*Mar.*), Jum (*Beng.*), Karivembu maram (*Tam.*), Garuga chettu (*Tel.*).

History, Uses, &c.—Throughout India the fruit of this tree, which is greenish yellow and about the size of a gooseberry, is pickled and eaten as a cooling and stomachic remedy; it is strongly acid. The bark is astringent, and is employed in tanning. (*Brandis.*) Its juice, which is gummy and resinous, is dropped into the eye to cure opacities of the conjunctiva. In the Concan the juice of the leaves, with that of *Adhatoda Vasica* and *Vitex trifolia,* mixed with honey, is given in asthma.

Description.—The gum-resin is greenish yellow, translucent, in small mamilliform masses, having a mild terebinthinate odour and taste, not unlike that of some sample of elemi. Only a small part of it is soluble in rectified spirit.

Chemical composition.—The gum-resin contains 76·5 per cent. of gum, 13·9 per cent. of resin, and 9·6 per cent. of moisture, including volatile oil. The gum is precipitated by ferric salts, but not by neutral plumbic acetate, it is therefore similar to that of myrrh. The resin is neutral, soluble in spirit of wine and ether, but not in alkalies. A clean sample of the gum-resin left 3·75 per cent. of ash.

CANARIUM STRICTUM, *Roxb.*

Hab.—Western Peninsula. The resin. Black Dammar (*Eng.*).

Vernacular.—Kala-dámar (*Hind.*), Karrapu-dámar (*Tam.*), Nalla-rajan (*Tel.*).

History, Uses, &c.—The black dammar tree of Malabar is common about Courtallum in the Tinnevelly district and in Canara. In the Wynaad the Kurchias light a fire at the base of the tree, on the side to which it is inclined. When the bark has been charred the resin begins to exude;

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about five or six months after it is removed in large stalactitic masses. It is used in India for many small purposes, such as the manufacture of bottling wax, varnishes, &c. Dr. Bidie speaks of it as an excellent substitute for Burgundy pitch.

Description.—The resin is transparent and of a deep brownish yellow to amber colour when held between the eye and the light, but when adhering to the tree it has a bright shining black appearance. Its colour when in solution is pale, as compared with its dark tint when in mass; though insoluble in spirit, its solution in turpentine forms a tolerable varnish. When submitted to destructive distillation it yields about 78 per cent. of oil, resembling that obtained from common colophony.

Commerce.—The high price of black dammar, about Rs. 32 per cwt. (*Beddome*), precludes its use as a substitute for colophony, nor can it compete with olibanum as a plaster material.

CANARIUM COMMUNE, *Linn.*

Fig.—*Kaning. Ann. Bot. i.* 360, *t.* 7, *f.* 2; *Bentl. and Trim.* 61. Java almond (*Eng.*), Bois de colophane (*Fr.*)

Hab.—Penang, cultivated in Southern India.

Vernacular.—Kánári (*Malay*).

History, Uses, &c.—This tree is described and figured by Rumphius (*Herb. Amb. II., tt.* 47, 48,) as a large tree growing at Ceram and in the neighbouring large islands which produces resin so abundantly that it hangs in large pieces and conical tears from the trunk and principal branches. The resin is at first white, liquid and sticky, but afterwards becomes yellowish and of the consistence of wax. Rumphius also mentions the almonds, which he says are apt to bring on diarrhœa and dyspepsia if eaten raw. Sprengel suggests (*Hist. Rei Herb. ii., p.* 270,) that the almonds are the منشم (Manshim) of Ibn Sina, which that author describes as three-angled seeds like those of the بطم (*Pistacia Terebinthus*), but the Arabian lexicographers consider manshim to be Carpobalsamum. Ainslie says:—"We are told by Horsfield in his list of medicinal plants of Java, that the gum has the same virtues as Balsam of Copaiba, that the three-cornered nuts are eaten both raw and dressed by the natives, and that the oil is used at table when fresh and for burning when stale." The resin is also said to be burnt as a light. Dr. Waitz (*Diseases of Children in Hot Climates*, p. 290), speaks favourably of an emulsion of the kernels as a substitute for Mistura Amygdalæ, to which he considers it preferable on account of its mild laxative action. Guibourt (iii., p. 520) notices the resin under the name of *New Guinea Resin with an elemi odour.*

Planchon (*Drogues Simples* ii., 244), speaking of the resin of this tree, says that under the name of *East Indian Elemi* it has occasionally appeared in commerce at Amsterdam as an import from the Dutch Colonies. In Java the tree is cultivated for its seeds; in India it is grown most successfully in Travancore.

Description.—The resin occurs in large dry masses of a yellowish-white colour, it readily softens when heated, and has then an odour like elemi.

The fruit is from 1¼ to 1½ inch long, ovoid, 3-angled, pointed at the apex, smooth, purplish, with a thin fleshy epicarp, nut very hard, 3-angled, indehiscent, 1-celled by abortion of the other two; the almond consists of a membranous testa, enclosing the oily cotyledons, which are divided into three lobes, folded and twisted together. The kernels yield 40 per cent. of a semi-solid fat of an agreeable and sweet taste, which keeps very long without turning rancid. (*Brannt.*)

C. bengalense, *Roxb.*, a native of Sylhet and the adjoining districts, is described by Roxburgh as an immense forest tree. "From fissures or wounds in the bark a large quantity of very clear amber-coloured resin exudes, which soon becomes hard and brittle, and is then not unlike copal; yet the natives set little or no value upon it. In the Calcutta bazar it is only valued at from 2 to 3 rupees for 7 maunds of 80 lbs. weight each." (*Flora Indica.*) The resin is not now known in Calcutta, but Dr. King informs us that it is still sold in Darjeeling under the name of *Gokal-dhup*, the Paharia name of the tree, and is used by the Lepchas to burn as incense.

Cancamum.—Fée suggests that the κάγκαμον or κάγκαλον of the Greeks was probably a gum resin obtained from a plant belonging to this order, and Sprengel suggests that it may have been the resin of a Gardenia.

If we refer to Dioscorides we find that he speaks of it as an Arabian gum, something like myrrh in appearance, used for fumigation on account of its fragrance, and administered medicinally to reduce corpulence and to cure spleen, &c., and also as an emmenagogue; it was applied locally to remove opacities of the cornea and improve the sight, also to cure toothache; acording to Paulus Ægineta it was considered to be laxative.

We think there can be no doubt that this substance was the *Kankahar*, *Kaikahan*, or *Kaighaman* of the Arabians, a kind of Rosin which they describe as having exactly the same properties as those attributed to Cancamum by Dioscorides. Haji Zein the druggist (A.D. 1368) describes it as having the appearance of Copal, and the Indian Mahometan writers on Materia Medica identify it with the Rála or Dhuna of India, which is *Shorea resin*, and which is used throughout the East as incense. Pliny (12, 44) mentions Cancamum and Tarum (Aloe wood) as coming from the country which produces cinnamom and cassia, and brought to Europe by the Nabatæan Troglodytæ, a colony of the Nabatæi.

MELIACEÆ.

MELIA AZADIRACHTA, *Linn.*

Fig.—*Bentl. and Trim.*, *t.* 62; *Wight Ic.*, *t.* 17. Indian Lilac (*Eng.*), Azadirac d'Inde (*Fr.*).

Hab.—India. The bark, root, leaves, flowers, fruit, gum, and oil of the seeds.

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Vernacular.—Nimb (*Hind.*), Nim (*Beng.*), Nimb, Bálata-nimb (*Mar.*), Bevina-mara, Isa-bevu (*Can.*), Nimbamu, Vepa-chetta (*Tel.*), Vembu, Veppam (*Tam.*), Limbado (*Guz.*).

History, Uses, &c.—This tree, in Sanskrit Nimba and Arishta, is a native of India, and is cultivated in all parts of the country on account of its medicinal properties. The leaves, bark and other products of the Neem have been articles of the Hindu Materia Medica from a very remote period, and are mentioned in the Ayurvedas of Susruta. The bark is considered to be bitter, tonic, and astringent. The leaves are added to poultices to disperse glandular tumours, and are used generally as a discutient; beaten into a pulp they are applied to pustular eruptions, more especially to the eruption of small-pox; their juice is anthelmintic, and is given in a variety of diseases, such as jaundice, prurigo, boils, &c. Chakradatta recommends a poultice of the leaves mixed with Sesamum seeds for unhealthy ulcerations. The fruit is described as purgative, emollient, and anthelmintic. The oil of the seeds is applied to suppurating scrofulous glands, is given in leprosy, rheumatism, and a variety of diseases. It is vermifuge, and is a remedy for mange in dogs. It has been used in the manufacture of soap. As the oil contains a marked amount of sulphur, *neem oil soap* might possibly be useful in cutaneous affections in which a mild sulphuretted application is indicated. The beneficial effects of the oil when rubbed into the skin in rheumatism is doubtless due to the presence of organically combined sulphur. The gum is said to have stimulant properties. The young trees tapped yield a saccharine juice, which when fermented is used as a stomachic; several observers have noticed that in certain years this juice appears to flow with unusual abundance.

The dried flowers are used as a tonic after fever, and under the name of *Pancha-nimba,* a medicine is prepared which contains the flowers, fruit, leaves, bark, and root of the tree, of each 15 parts, and one part each of a number of other drugs. The nimba is also one of the *Pancha-tikta* or five bitters.

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The air waved with a Neem branch is supposed to be a cure for syphilis. The insane are passed through a cleft of the tree, or a stem which having parted and re-united forms a circular opening. Buchanan, in his "Journey through Mysore," relates that—"Once in two or three years the Coramás of a village make a collection among themselves, and purchase a brass pot, in which they put five branches of *Melia Azadirachta* and a cocoanut. This is covered with flowers and sprinkled with sandalwood water. It is kept in a small temporary shed for three days, during which time the people feast and drink, sacrificing lambs and fowls to Marima, the daughter of Siva; at the end of the three days they throw the pot into the water." This practice is known in other parts of India as घटस्थापन (Ghatasthapan), and is considered to avert ill luck and disease. Amongst certain castes the leaves of the Neem are placed in the mouth on their return from funerals as an emblem of grief. Five to eight leaves are eaten by all Hindus on the first day of the New Year, and are supposed to ensure freedom from disease; when amrita (ambrosia) was being conveyed to heaven from the lower world for the use of the gods, it is believed that a few drops of it fell on this tree. For an account of the mythology of amrita, *see* De Gubernatis, Myth. des Plantes I., p. 32.

This useful tree naturally attracted the attention of the Mahometans upon their arrival in the country, and they named it Azaddarakht-i-Hindi, from its resemblance to the *Melia Azedarach* or Persian Lilac. The author of the Makzan-el-Adwiya is careful to point out that the Indian Neem is not found in Persia. He describes the Neem and Azadarakht separately, giving Bakayan as the Indian name for the latter. The Mahometans use the different products of the Neem in the same manner as the Hindus, and like them consider it to be cold and dry. Amongst European physicians, Wight says, "The leaves beaten to a pulp, and externally applied, act like a charm in removing the most intractable forms of psora and other pustular eruptions." Dr. White, of Bombay, has recommended the bark as a febrifuge; others have spoken

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favourably of the leaves as a local application to ulcers and certain obstinate skin diseases. Dr. Hové (1787) thus speaks of the Neem tree:—"The Gentoos here worship this tree, and their barren women invoke and perform the same ceremonies round it every morning as they usually do in the other Pergunnahs about the *Ficus religiosa*. The leaves are of a powerful bitter, and they use a strong decoction with great success in intermittents, and which I usually drank for my liver complaint and found myself much relieved by it." He also notices the use of the gum by lying-in women.—(*Hové, account of Mitampoor.*) From recent experience detailed in the Pharmacopœia of India, it would appear that the opinion of the natives of India regarding the medicinal properties of the different parts of this tree is substantially correct. The bark is now official in the abovementioned Pharmacopœia.

Description.—Neem bark is coarsely fibrous; it varies much in thickness according to the age of the tree from which it is taken. The external surface is rough, fissured, and of a rusty grey colour; the inner surface yellowish and foliaceous. The taste is bitter and astringent. The leaves are simply pinnate, leaflets 9 to 15, ovate, lanceolate, unequal sided, acuminated, serrated, 1 to 3 by $\frac{1}{2}$ to $1\frac{1}{2}$ inches, very bitter. The fruit when ripe is purple, 1-celled, 1-seeded, $\frac{1}{2}$ to $\frac{3}{4}$ in. long; within the fleshy portion is a thin hard woody shell, which encloses an oily bitter kernel like a small filbert, greenish white, with a brown testa. The dried fruit resembles a small raisin, the inner portion of the pulp is adherent to the stone, and fibrous from the presence of very large liber cells. The expressed oil is of a pale yellow colour and bitter taste. It has a powerful garlic-like odour. The gum is yellowish, like inferior gum Arabic, generally in longish vermiform pieces, not bitter, and freely soluble in cold water. It is unaffected by neutral acetate of lead, gives a curdy white precipitate with basic acetate, a reddish gelatinous precipitate with ferric chloride, is unaffected by borax, is slightly reduced by boiling with Fehling's solution, which it turns of a dull red colour. Iodine does not affect it, but it precipitates with oxalate of ammonia. It makes a weak mucilage, and is of little value.

Microscopic structure.—According to the *Pharmacographia*, the suberous coat consists of numerous layers of ordinary cork cells, which cover a layer of nearly cubic sclerenchymatous cells. This latter, however, is not always met with, secondary bands of cork (rhytidoma) frequently taking its place. The liber is commonly built up of strong fibre-bundles traversed by narrow medullary rays, and transversely separated by bands of parenchymatous liber tissue. Crystals of oxalate of calcium occur in the parenchyme more frequently than the small globular starch grains. The structure of the bark varies considerably according to the gradual development of the secondary cork bands. We have examined the fresh bark and find that it agrees with this description.

Chemical composition.—An infusion of the bark gives with perchloride of iron a blackish precipitate; the infusion is not altered by tannic acid or iodo-hydrargyrate of potassium. If the inner layers of the bark are alone exhausted with water, the liquid affords an abundant precipitate with tannic acid; but if the entire bark is boiled in water, the tannic matter which it contains will form an insoluble compound with the bitter principle and prevent the latter being dissolved. (*Pharmacographia.*) According to Broughton, the bitter principle of the bark is a neutral resin, having scarcely any definite reactions. It may be obtained by exhausting the bark with alcohol of 60 per cent., precipitating the filtered tincture with water, and purifying the precipitate by solution successively in benzene, carbon bisulphide, dry ether, and finally, absolute alcohol. It is soluble in strong boiling solutions of the fixed alkalies, from which acids precipitate it apparently unaltered. It does not form definite compounds with acids or with bases, but on treating it with nitric acid and precipitating with water, a nitro-derivative is obtained, having the composition $C^{36} H^{46} (NO^2)^4 O^{11}$, hence the formula of the bitter principle is inferred to be $C^{36} H^{50} O^{11}$.

The leaves contain a small quantity of a bitter substance of a similar character but much more soluble in water. This substance, also contained in the bark, is a hydrate of the resin, which it closely resembles in its properties.—(*Pharm. Journ.*, (3), iii. 992.)

Margosa or Neem oil extracted from the seeds and examined by Warden had a specific gravity of ·9235 at 15·5° C.; at about 10°—7° C. it congealed without losing its transparency. After standing for about 36 hours the recently expressed oil deposited a white sediment, which examined microscopically was found to be amorphous. The colour reactions of margosa oil were not characteristic. With concentrated sulphuric acid a rich brown colour was yielded, and a strong garlic odour evolved. By Massie's test with nitric acid the oil became almost immediately of a reddish colour; after standing about one hour and thirty minutes the colour was pale yellow. The elaidin reaction conducted according to Poutet's directions yielded a solid firm yellowish product after eighteen hours, the temperature in the laboratory varying between 89° and 93° F. Exposed in a thin layer on a glass plate to a temperature of 100° C. for some days the oil did not dry or become tacky. The oil was easily soluble in ether; chloroform, carbon bisulphide, benzole, &c. Absolute alcohol agitated with it was coloured greenish; on separating the alcohol, and evaporating off the spirit, an extract was obtained which consisted of oil, from which a small residue, whitish in colour, separated on standing. The alcoholic extract was very bitter, and possessed in a marked degree the peculiar odour of the oil. The whitish residue deposited from the oil separated by alcohol, and examined microscopically, did not appear crystalline. Margosa oil after repeated agitation with alcohol was found to have lost its bitterness and almost wholly its alliaceous odour.

A known weight of the oil was saponified with alcoholic potash, the alcohol completely evaporated off, and the soap dissolved in water. On agitating the aqueous solution of the soap with ether, 1·60 per cent. of ether extract was obtained of an orange-yellow colour and bitter. This extract, treated with 60 per cent. alcohol, left a small amount of white residue, which had the character of a wax. The aqueous solution of the soap, after separation of the ether, was heated for some time to remove dissolved ether, the solution was then mixed with dilute sulphuric acid in excess, and the insoluble separated from the soluble fat acids in the manner recommended by Allen.* The soluble fatty acids amounted to 3·519 per cent., the insoluble to 89·128 per cent. The volatile acids consisted of butyric and a trace of valeric acid. During the distillation to separate the fluid from the volatile fatty acids, a small amount of a snow white fatty acid passed over; this acid had a melting point of 43·6° C., which corresponds with the fusing point of lauric acid. A weighed portion of the insoluble fatty acids, from which the lauric acid had not been separated, was dissolved in alcohol, and titrated with normal standard soda, using phenolphthalein as an indicator, ·288 gram of the acids required 1 c.c. of caustic soda for neutralization. No attempt at separating the fixed fatty acids was made; they probably consisted of a mixture of stearic and oleic acids, with a small amount of lauric acid.

Examined by Reichert's distillation process, 2·5 grams of the oil gave a distillate which after separation of the lauric acid, which had distilled over, required 4·6 c.c. of decinormal soda for neutralization, phenolphthalein being used as an indicator.

The saponification equivalent of the oil was determined by Koettstorfer's method, and was equal to 284, the percentage of caustic potash required to saponify the oil being 19·72.

A preliminary examination of the oil having indicated the presence of sulphur, a quantitative estimation of the amount present was made and found equal to ·427 per cent. The oil after repeated agitation with alcohol was found to contain only ·109 per cent. of sulphur.

The extract obtained by agitating the oil with absolute alcohol has already been referred to; it was examined in the following manner:—The oily extract was treated with 60 per cent. spirit,

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* 'Commercial Organic Analysis.'

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allowed to stand, and the clear yellow alcoholic solution decanted from the insoluble oil; the alcoholic solution thus obtained was evaporated to dryness, mixed with ammonia, and agitated with ether. The ether solution was marked *A*. The aqueous solution, after separation of the ether, was mixed with dilute hydrochloric acid, and again agitated with ether. The ether separated of a yellow colour, and below it some flocks of a dirty yellow hue, which refused to dissolve after prolonged agitation. The ether solution was marked *B*. From the aqueous solution the insoluble flocks were separated by filtration and marked *C*. The filtrate was not further examined.

Examination of ether solution A.—The solution was agitated with dilute hydrochloric acid, to remove any principles of an alkaloidal nature. The ether was then separated and evaporated; the resulting extract was pale amber in colour, viscid at first, very bitter, and had a marked odour of the oil. It contained sulphur. It was easily soluble in 60 per cent. alcohol, ether, chloroform, &c., but insoluble in acids, or in caustic alkaline solutions. It had the properties of a neutral resin.

The hydrochloric acid solution was of a yellow colour; it was mixed with ammonia, which occasioned a white precipitate, and agitated with ether. The ethereal solution on evaporation left a yellow residue, not readily soluble in dilute acids. The dilute sulphuric acid solution was bitter, and yielded a precipitate with alkaline carbonates and hydrates, phosphomolybdic, and picric acids, potassio-mercuric iodide, chloride of gold and perchloride of platinum. This principle had therefore the properties of an alkaloid.

Ether solution B.—On evaporating the ether solution *B*, a dark reddish bitter extract was obtained, soluble in alkaline solutions, and re-precipitated in yellowish flocks by dilute acids. It had the properties of an acid resin

Precipitate C.—The precipitate was well washed, and dissolved in alcohol; on evaporation a brittle darkish residue was obtained, soluble in alkaline solutions, re-precipitated in yellowish flocks by acids, soluble with very great difficulty in ether,

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easily soluble in chloroform. This principle thus also had the properties of an acid resin.

In addition to the principles above described as being present in the oil, an examination of the cake left after expression of the oil, indicated the presence of another neutral principle, insoluble in ether or alkaline solutions, but dissolving in chloroform.—(*Pharm. Journ.*, 1888.)

According to Brannt the seeds contain from 40 to 45 per cent. of oil.

Margosa cake is used as a manure in planting districts in Southern India. Two samples had the following composition:

	1	2
Moisture	6·08	9·93
Organic matter	84·50	83·15
Ash	9·42	6·92
	100·00	100·00
Nitrogen	5·07	5·41
Phosphoric anhydride	1·40	1·33

The powdered cake, like linseed meal, makes a very useful luting in chemical and physical laboratories, and is not liable to the attack of insects.

MELIA AZEDARACH, *Linn.*

Fig.—*Wight, Ic. t.* 160; *Bot. Mag., t.* 1066. Persian Lilac, (*Eng.*), Azédarac commun (*Fr.*).

Hab.—Himalaya, Persia. Cultivated elsewhere. The root-bark, fruit, flowers and leaves.

Vernacular.—Bakayan (*Hind.*), Bakána-nimb, Vilayati-nimb (*Mar.*), Malaivembu, Malai-veppam (*Tam., Mal.*), Bettada-bevina (*Can.*), Drek (*Punj.*), Konda-vepa, Turaka-vepa (*Tel.*), Ghora-nim (*Beng.*).

History, Uses, &c.—The Persian Lilac was probably introduced into the southern parts of India by the Mahometans. Haji Zein says that in Tabristan it is called Takhak, and in Shi-

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raz Taghak, both corruptions of Ták, its proper Persian name. It is a native of the sub-Himalayan tracts, and is called in Sanskrit Mahanímba and Himadruma. The Hindus do not appear to have paid much attention to it, but it has been described by Ibn Sina in his second book under the name of Azaddarakht, and has long been used by the Arabs and Persians, who consider it to be hot and dry, and to have deobstruent, resolvent, and alexipharmic properties. The flowers and leaves are applied as a poultice to relieve nervous headaches. The juice of the leaves administered internally is said to be anthelmintic, antilithic, diuretic, and emmenagogue, and is thought to resolve cold swellings, and expel the humours which give rise to them. The bark and leaves are used internally and externally in leprosy and scrofula. A poultice of the flowers is said to kill lice and cure eruptions of the scalp. The fruit has poisonous properties, but nevertheless is prescribed in leprosy and scrofula, and is worn as a necklace to avert contagious diseases. In China it is used as a vermifuge.

Loureiro states that the Chinese boil the berries in wine and then make a decoction of them, which has no injurious effects. The leaves and bark they use in itch and other skin diseases.

The root-bark of *M. azedarach* is placed in the secondary list of the United States Pharmacopœia as an anthelmintic. It has a bitter, nauseous taste, and yields its virtues to boiling water. It is administered in the form of decoction (4 ozs. of the fresh bark to 2 pints of water, boiled to one pint), of which the dose for a child is a tablespoonful every third hour until it sensibly affects the bowels or stomach, or a dose may be given morning and evening for several days and then be followed by a cathartic.

Toxicology.—In large doses it produces narcotism followed by death. Dr. Burton Brown (*Punjab Poisons*) records a case in which a European girl ate the berries, became insensible and died. Descourtilz says that 6 to 8 seeds cause nausea, spasm, and choleraic symptoms, sometimes followed by death.

Description.—The fresh root-bark is thick and rather spongy, the external surface scabrous and warty, of a dark brown colour; beneath the suberous layer it is of a deep pink; the inner surface is white; taste acrid, nauseous, astringent, and slightly bitter. The tree yields a soluble gum very similar to that obtained from the Neem.

Chemical composition.—J. Jacobs has found the active principle to be a light yellow, non-crystalline bitter resinous substance without alkaloidal properties. Sugar is present and tannin occurs in the outer portion of the bark. The activity resides in the liber, and this alone is recommended to be used for medicinal preparations. (*Pharm. Journ.*, 27*th September* 1879.)

MELIA DUBIA, *Cav.*

Fig.—*Beddome, Fl. Sylv. t.* 12.

Hab.—E. and W. Peninsulas, Burma, Ceylon. The fruit.

Vernacular.—Dinkarling (*Hind.*), Kadu Khajur (*Guz.*), Nimbara (*Mar.*), Kád-bevu, Ara-bevu (*Can.*).

Description, Uses, &c.—The dried fruit of this tree is supposed to be the Arangaka of Sanskrit writers. In size, shape, and colour it is very much like a date, but upon closer examination the pulp is found to adhere firmly to a large and very hard stone. The remains of the peduncle may also be seen to be different from that of a date. When soaked in water the fruit soon loses its shrivelled appearance and becomes like an oval yellowish-green plum. The skin is now seen to be thick and easily separated from the pulp, which consists of a delicate parenchyme supported by fibrous bands attached to the stone. The apex of the fruit is blunt, and studded with small tubercles. At the base is attached the five-partite calyx, and a small portion of the fruit stalk. The stone is an inch in length, obscurely five-furrowed, oblong, perforated at both ends; apex 5-toothed round the perforation, 5-celled, or less from abortion; seeds solitary, lanceolar, attached from the apex; perisperm in small quantity; embryo straight, inverse; cotyledons lanceolate; radicle

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oval, superior. The seed is $\frac{3}{4}$ of an inch long and $\frac{5}{6}$ broad; testa dark-brown or black, polished, kernel very oily, sweet-tasted. The pulp of the fruit has a bitter nauseous taste. It is a favourite remedy amongst the labouring classes for colic, half a fruit being the dose for an adult. It appears to have hardly any purgative properties, but is said to relieve the pain most effectively, and to act as an anthelmintic. In the Concan the juice of the green fruit with a third of its weight of sulphur and an equal quantity of curds heated together in a copper pot is used as an application to scabies, and to sores infested with maggots.

Chemical composition.—The bitter principle of the fruit is a white crystallizable glucoside soluble in ether, alcohol and water; it is precipitable from its aqueous solution by tannin and alkaloidal reagents but not by plumbic acetate, and it has a slight acid reaction. Sulphuric acid dissolves it with a deepening of colour, discharged on the addition of water. Boiled with diluted hydrochloric acid it is decomposed in less than half an hour into glucose and a colouring matter. Petroleum ether removes a fatty oil of nauseous property, and ether dissolves a tasteless wax of greenish colour soluble in boiling alcohol and only slightly in petroleum ether; besides these constituents, malic acid, glucose, mucilage and pectin occur in the fruit.

Commerce.—The fruits are sold in the bazar at Re. 1-4 per lb.

NAREGAMIA ALATA, *W. & A.*

Fig.—*Rheede, Hort. Mal. x.*, *t.* 22; *Wight Ic. t.* 90.

Hab.—W. Peninsula. The stem and roots.

Vernacular.—Pittvel, Pittpápra, Pittmári, Tinpáni (*Mar.*), Nela-naregam (*Mal.*), Nela-naringu, Nalakanu-gida (*Can.*), Trifolio (*Goa.*)

History, Uses, &c.—This is the country Ipecacuanha of the Portuguese at Goa. Garcia d'Orta, who calls it *Avacari*

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(ओकारी = emetic), mentions a wonderful cure of a case of dysentery treated by a decoction of the bark in rice water, but he appears never to have seen the plant, as he says:—"Esta raiz desta matta dizem que cheira a trevo." (*Coll.* 27.)* The Goanese name Trifolio appears to be a translation of the Marathi Tinpáni. It has a somewhat pungent, aromatic odour, but hardly any taste, and is given as an emetic in doses of from 12 to 18 grains. In Southern India it is used as a remedy for rheumatism and itch. (*Rheede.*) In the Concan the Hindus use the leaves and stems in decoction with bitters and aromatics as a remedy for biliousness. Naregamia has recently been tried in Madras in acute dysentery, and also as an emetic and expectorant with results similar to those obtained from Ipecacuanha given in equal doses. The forms for administration are the powder and tincture (2½ ozs. to 1 pint of rectified spirit). It has been used with good result at the General Hospital at Vienna in the form of a fluid extract which is of a bright golden-brown colour, and has an odour recalling that of *Valeriana celtica*; when the extract is diluted with water it becomes turbid and milky, and on the addition of more water opalescent. The dose of this preparation is from 3 to 5 grams in 20 grams of distilled water or aqua laurocerasi.—(*E. Ghillang. Ztschr. d. All Œst. Ap. Ver.* 1889, *p.* 279.)

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* Garcia's account of this drug is as follows:—

"Ha tambem nesta ilha uma arvore pequena, e porém de maior quantidade que esta outra frutice; tem as folhas e a flor como a *murta* (myrtle) e dá a fructa como *murtinhos* (myrtleberries), e do mesmo sabor e mais estiticos, e chamam esta herva *avacari*. Esta, me dice um Portuguez velho de muito tempo nesta terra, que mora no monte em uma sua quinta, que aproveita muito para camaras (dysentery) antigas de cauza fria; e que teve, por espaço de um anno, uma filha enferma de camaras, e que as outras mezinhas lhe não aproveitavam, e com esta fór restituida a saude; e perguntei-lhe quem lhe dicera que esta planta era boa pera camaras, e dice que um destes physicos da terra lhe dava a corteza pisada, e lançada em aqua d'arroz, feita a modo de tizana, que e o modo que tem no hospital de curar. Esta raiz desta mata dizem que cheira a trevo: e perguntei aos physicos desta terra por ella, e diceram me que era boa pera camaras, e que a misturavam com outra herva chamada *Coru* (*Holarrhena antidysenterica*) e que é muito boa misturada. Isto é o que sei destas mizinhas, e eu vos levarei a ver enfermos que curam os Malavares e os Canarins, e sabereis melhor tudo."

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Description.—It is small woody shrub which grows on the banks of water-courses in shady places, seldom more than 6 to 8 inches high, consisting of several slender stems, sparingly branched, and rising from a spreading rootstock, which is contorted, knotty and warty. The leaves are alternate, mostly situated at the ends of the branches, and consist of a narrow winged petiole, $\frac{3}{4}$—1 inch long, at the end of which are articulated three small cuneate-obovate leaflets. The ends of the shoots and buds are seen under the microscope to be thickly covered with white simple hairs; the petiole and leaflets are nearly free from them. The flowers are large and white on axillary peduncles; the capsules 3-angled and 3-valved. The drug consists of the creeping root with the slender stems attached to it, the leaves having been stripped off.

Microscopic structure.—A section of the root presents a tolerably thick dry suberous layer of a brown colour; immediately within this, the parenchyma, which is composed of thin walled cells, is much loaded with a yellowish oil. In the inner portion of the bark the cells contain starch; the wood is very hard and of a greenish yellow colour.

Chemical composition.—The drug has been examined by Hooper (*Pharm. Journ.* [3], xviii. 317), who found that the ether extract contained an *alkaloid*, *an oxidizable fixed oil* and a *wax.* The alkaloid was separated by agitating the extract with diluted sulphuric acid, and the clear colourless solution at once afforded precipitates by the usual reagents. The alkaloid was left as an amorphous, slightly coloured residue of a brittle consistence, on the gentle evaporation of its ethereal solution. It formed crystalline salts with sulphuric, nitric and hydrochloric acids, but gave no satisfactory colour reactions when mixed with the concentrated acids. It was precipitated from its solutions by tannin, potassio-mercuric iodide, phosphomolybdate of soda, and iodine. It differs from emetine in readily forming acicular crystals with acids, and by not giving any colour with chlorinated lime and acetic acid; and it differs

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from the principal cinchona alkaloids by its optical inactivity. Hooper proposes to call the alkaloid *Naregamine*. The fixed oil was soluble in strong spirit, also in dilute caustic soda with a brown and red fluorescent solution. The *wax* was insoluble in spirit; it was coloured brown and afterwards black by sulphuric acid. The alcoholic extract consisted mainly of *sugar* with some little resinous matter. No tannic substances were detected, but a body precipitable by neutral plumbic acetate, related to an organic acid. The aqueous extract evaporated to a small bulk, and treated with two volumes of alcohol, gave a precipitate of gum. The filtrate from this evaporated and treated with four volumes of alcohol, caused a precipitate which after standing some hours separated out into large colourless rhombic prisms, probably *asparagin*. Among the less important constituents of Naregamia are albuminous, pectinous, and colouring matters, starch, cellulose, woody fibre and ash. The starch is in minute rounded granules of about the same size as rice-starch. The ash is of a reddish colour, and ten per cent. of it is insoluble in hydrochloric acid. The following is the result of the analysis:—Ether extract 2·93, alcoholic extract 5·40, aqueous extract 7·00, albuminous matter, &c., 7·61, starch and cellulose 17·66, woody fibre 4·77, ash 5·52, moisture 9·11—total 100·00.

Commerce.—The drug is collected and supplied by Messrs. Hinde and Co., Calicut.

SOYMIDA FEBRIFUGA, *Juss.*

Fig.—*Bentl. & Trim., t.* 63. Redwood tree (*Eng.*).

Hab.—N. W., Central and S. India, Ceylon. The bark.

Vernacular.—Rohan or Rohán (*Hind., Beng.*), Shemmaram *Tam.*), Cheve-mánu, Somida-mánu (*Tel.*).

History, Uses, &c.—The astringent and febrifuge properties of this bark are known to both Hindus and Mahometans, and notices of it are to be found in some of their books on Materia Medica under the name of Rohan.

Roxburgh was the first to introduce it to the notice of Europeans as a substitute for the Peruvian bark. Ainslie describes it and says, "given to the extent of four or five drachms in the twenty-four hours I have found it to be a useful medicine, but beyond that quantity, it, in every instance in which I tried it, appeared to me to derange the nervous system, occasioning vertigo and subsequent stupor." The authors of the Bengal Dispensatory thus summarize its properties:—"It seems to us to be exactly similar to the mahogany bark, useful where astringent tonics are applicable, but of very questionable efficacy as a true antiperiodic." In 1791, Roxburgh sent the bark to Edinburgh, where Duncan made it the subject of a thesis,* which led to its admission into the Edinburgh and Dublin Pharmacopœias. It appears never to have attracted much attention in England, but recently it has been made official in the Pharmacopœia of India as a useful astringent tonic.

Description.—Flückiger and Hanbury describe the bark from a young tree as occurring in straight or somewhat curved half tubular quills, an inch or more in diameter, and about 1-5th of an inch in thickness. Externally it is of a rusty grey or brown, with a smoothish surface, exhibiting no considerable furrows or cracks, but numerous small corky warts. These form little elliptic scars or rings, brown in the centre, and but slightly raised from the surface. The inner side and edges of the quills are of a bright reddish brown. A transverse section exhibits a thin outer layer coloured by chlorophyll, and a middle layer of a bright rusty hue, traversed by large medullary rays and darker wedge-shaped rays of liber. The latter has a fibrous fracture, that of the outer part of the bark being rather corky or foliaceous. The whole bark when comminuted is of a rusty colour, becoming reddish by exposure to air and moisture. It has a bitter astringent taste, with no distinctive odour. (*Pharmacographia.*) To this we may add that the old bark has a ragged dry suber, a quarter of an inch thick, and of a rusty blackish brown colour, deeply fissured longitudinally, and minutely cracked transversely; the small corky warts described above are still visible here and there between the fissures. Old bark is generally in half quills, the total thickness being about half an inch; its colour is a rich red brown; its substance when soaked in water becomes very compact.

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* Tentamen de Swietenia Soymida, Edin. 1794.

Microscopic structure.—The ring of liber is made up of alternate prosenchymatous and parenchymatous tissue. In the latter the larger cells are filled with mucilage, the others with starch. The prosenchymatous groups of the liber exhibit the peculiar form known as *hornbast*: it chiefly contains the tannic matter, besides stellate crystals of oxalate of calcium, which are distributed through the whole tissue of the bark. The corky coat consists of vaulted cells.

Chemical composition.—The bitter principle of the bark has been ascertained by Broughton to be a nearly colourless resinous substance, sparingly soluble in water, but more so in alcohol, ether or benzol. It does not appear to unite with acids or bases, and is less soluble in water containing them than in pure water. It has a very bitter taste, and refuses to crystallise either from benzol or ether. It contains no nitrogen. The bark is rich in tannic acid. The tree yields a gum which forms a good adhesive mucilage having a dextro-rotatory property with polarized light. It thickens immediately with ferric chloride, and gives no precipitate with neutral plumbic acetate. The ash amounts to 2·11 per cent.

Commerce.—The bark is not an article of commerce.

Barks of a similar character are yielded by—

Chloroxylon Swietenia, *DC., Wight Ill. i., t.* 56; *Bedd. Fl. Sylv.,* t. 11. Billu (*Tel.*), Haladaraya, Bheriya (*Mar.*), Mududa, Vummaay, Kodavaporsh (*Tam.*), a native of the Western Peninsula and Ceylon, yields an astringent bark which is sometimes prescribed by Hindu physicians under the names of Raktarohida and Ragatrora, a name applied in India to several astringent barks. The suber of this bark is dark brown, and very rough from the presence of numerous elliptic corky lenticels; it is very loosely attached, and when removed leaves a nearly smooth pale red surface. The tree also affords a soluble exudation allied to gum arabic, which occurs in amber-coloured tears, more or less cracked. It swells in water to a whitish and transparent jelly; with more water it becomes liquid enough to pass through a paper filter. The solution has a slight acid reaction, it is coagulated without colour by ferric salts, and is not precipitated by neutral plumbic acetate. The gum affords a calcareous ash amounting to 4·16 per cent.

The wood of this tree is the *Satinwood* of India; it is oily, and turns well, making nice stethescopes, &c.

Cedrela Toona, *Roxb. Cor. Pl. iii.*, *t.* 238; *Bedd. Fl. Sylv. t.* 10. Tún (*Hind.*), Tuni (*Mar.*), Nandurike (*Can.*), Tunumaram (*Tam.*), and in Sanskrit Tunna and Nandivriksha, has a very astringent bark, which is used by native physicians in combination with Bonduc nuts as a tonic and antiperiodic. The flowers (*Gul-tun*), which are small, yellow, and sweet-scented, contain a yellow dye, and are considered to be emmenagogue. Nees von Essenbeck has published an account of some experiments made with the bark which indicate the presence in it of a resinous astringent matter, a brown astringent gum, and a gummy brown extractive matter, resembling ulmine. We find that the gum of this tree first swells, and then dissolves in water; the solution is unaffected by neutral plumbic acetate and ferric chloride, and is optically dextrogyrate. The gum leaves when burnt 4·68 per cent. of ash, consisting mainly of calcium carbonate. The wood resembles mahogany.

Chickrassia tabularis, *Adr. Juss. Wight Ill. i.*, *t.* 56; *Bedd. Fl. Sylv. t.* 9, a tree of Eastern Bengal and of the Western Peninsula from the Concan to Travancore, has an astringent bark, without any bitterness, which is sometimes used as a febrifuge. The wood, which is close-grained and light-coloured, is known as *Chittagong wood*, or *White Cedar*, and is used by cabinet makers and coopers. The generic name of the tree is derived from the Bengali name *Chikrassi*; it is called in Tamil *Agil*.

WALSURA PISCIDIA, *Roxb.*

Fig.—*Wight Ill. i. t.* 55. *Syn.*—Trichilia trifoliata.

Hab.—W. Peninsula, Malabar, Travancore, Ceylon. The bark.

Vernacular.—Walsura (*Tam.*), Walurasi (*Tel.*).

History, Uses, &c.—Roxburgh records that the bark is used to stupefy fish in India, and that fish so caught are not considered unwholesome. Corre and Lejanne state that in the Antilles the tree is known as *Herbe à mauvaises gens* or *Herbe à méchants,* and that the bark acts as a dangerous emmenagogue and violent emetic.

Forskahl mentions a species (*Trichilia emetica*), called رقه (Rukeh) by the Arabs, the fruit of which is their Jauz-el-kai or emetic nut, and is used also in hair washes to kill lice, and made into an unguent, to cure itch. In India the Mahometans have adopted the fruit of *Randia dumetorum* as a substitute for the true Jauz-el-kai of the Arabs. (See *Randia.*)

Mr. Hollingsworth, Assistant to the Professor of Botany at the Medical College, Madras, has experimented with the bark off and on for about a year. He finds that it acts effectually as a fish poison, and he has eaten the fish killed with it and finds them quite wholesome. He says the bark is stimulant and expectorant, and thinks it must contain saponin.

Description.—The bark kindly supplied by Mr. Hollingsworth is about a quarter of an inch thick, and can easily be divided into a thick suber of a brown colour, very deeply and irregularly fissured in a longitudinal direction on the outer surface, with a tendency to separate in flakes; and an inner portion or liber of a light cinnamon colour, and very hard and compact. The taste is bitter and astringent, a transverse section of the bark magnified shows very numerous groups of stony cells arranged in rows at regular distances amongst the liber tissue.

Chemical composition.—The bark contains a resin anhydride in the alcoholic solution of the ether extract. It is light brown in colour, melting at about 80° C.; insoluble in water and in diluted acids and alkalies in the cold. Boiled with strong soda it is slowly dissolved. It is partly soluble in dilute sulphuric acid when boiled, and separates in lustrous scales on cooling. With strong sulphuric acid it dissolves with a deep red colour; this solution precipitates on the addition of water. It reduces Fehling's test, and its alcoholic solution is not affected by ferric chloride. Saponin is contained in the aqueous extract of the bark, and a large quantity of tannin, giving a greenish-black colour with ferric salts, is present in the extract obtained by spirit.

AMOORA ROHITUKA, *W. and A.*

Fig.—*Bedd. Fl. Syl. t.* 132; *Griff. Ic. iv., t.* 589, *f.* 3.

Hab.—Assam, Sylhet, Oudh, W. Peninsula. The bark.

Vernacular.—Harin-harrâ, Harin-khana, Sohaga (*Hind.*), Rohituk, Raktarohida (*Mar.*, *Tam.*, *Tel.*), Tikta-raj, Pitraj (*Beng.*), Amora-amari (*Assam.*); Mullamuttala-gida (*Can.*).

History, Uses, &c.—Hindu medical writers describe the properties of this tree, under the Sanskrit names of Rohituka, Rohini and Rohera, as aperient, and a remedy for enlarged glands, liver disease, spleen, and corpulence. It is considered to be of peculiar efficacy in enlargement of the spleen, hence it bears the synonyms of *Pliha-ghna*, "spleen destroyer," and *Pliha-shatru*, "enemy to spleen." *A. Rohituka* is an evergreen tree with large pinnate leaves and dull yellow or reddish fruit about 1½ inch in diameter, which are 3-celled and 3-valved, and usually contain three chestnut-coloured oblong seeds, enclosed in thick, fleshy, scarlet arils. Graham likens the fruit to a ball of Windsor soap. Roxburgh fully describes the tree under the name of *Andersonia Rohituka*, and states that where it is plentiful, the oil of the seeds is extracted for economical purposes. The bark appears to us to be a useful astringent.

Description.—Amoora bark is of a blackish-brown colour externally, and rough from the presence of numerous small, elliptic, warty projections, arranged longitudinally, and from minute fissures. Its substance is of a deep reddish-brown, and shows a striated internal surface; fracture short; when fresh it is soft and easily cut.

The bulk of the bark is composed of parenchyme cells, containing starch and colouring matter; there are numerous yellow stone cells arranged in broken concentric layers, and very little woody fibre. The bark has a very astringent taste and turns of a greenish black when touched with a solution of ferric chloride. It has no particular odour.

Chemical composition.—The bark contains two yellow resins soluble in ether, one of them insoluble in alcohol and alkaline solutions, the other soluble in such liquids and of an acid nature. The alcoholic extract contains both soluble and insoluble tannin, giving a dirty green reaction with ferric salts. A decoction of the bark gives a blue-black colour with iodine solution, showing the presence of abundance of starch, and the powder leaves 12 per cent. of mineral matter when burnt.

AGLAIA ROXBURGHIANA, *Miq.*

Fig.—*Wight Ic., t.* 166; *Bedd. Fl. Sylv., t.* 130.

Hab.—Western Peninsula; Ceylon.

Vernacular.—Priyangu (*Hind., Beng., Mar.*), Tottila-kayi (*Can.*).

History, Uses, &c.—This tree is the Priyangu of Sanskrit writers, and bears the following synonyms—Syáma, Kántatva, Nandini, Phalini, Lata; which form a very poetical description and may be translated:— Like a slender maiden of golden complexion, elegant, graceful, a fruit-bearing tree, with drooping branches; and a description the justness of which we have acknowledged by giving the name Aglaia (the bright one), one of the Graces, to the genus. The fruit is used in Hindu

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medicine, and is considered to be cooling and astringent, and useful in inflammatory, bilious, and febrile complaints; it is also thought to be beneficial in leprosy. The seeds appear to be the part to which the medicinal reputation of the fruit is due.

Description.—A large tree with pinnate leaves, and yellow flowers. Fruit $\frac{1}{2}$ to $\frac{3}{4}$ inch in diameter, sub-globose, very minutely pilose, 1 to 2 celled and seeded, buff-coloured when fresh, brown and wrinkled when dry. It consists of a thin shell inclosing 1 or 2 brown seeds, covered by a pink fleshy aril.

The seeds are flat, of somewhat irregular outline, with one side slightly convex; they are nearly half an inch in diameter and remarkably acid and astringent; when dry they have an aromatic odour.

Chemical composition.—The seeds deprived of their husks, dried at a low temperature and reduced to fine powder yielded 9·14 per cent. of moisture. The ash amounted to 2·91 per cent., and contained no manganese. With the exception of astringent matter which afforded the reactions for quercitannic acid, there is nothing special to note in connection with these seeds.

The bark of **Carapa moluccensis,** *Lam.*, the *Granatum littoreum* of Rumphius (iii., 92, t. 61), a tree of the muddy sea coasts of India and Ceylon, is bitter and astringent, and is employed by the Malays in colic, diarrhœa and other abdominal affections.

CELASTRINEÆ.

CELASTRUS PANICULATA, *Willd.*

Fig.—*Wight Ill.* 179, *t.* 72; *Ic. t.* 158.

Hab.—Hilly districts from Himalaya to Ceylon. The seed and oil.

Vernacular.—Málkanguni (*Hind.*, *Guz.*, *Mar.*, *Can.*), Gundumeda, Malkanguni (*Tel.*), Valuluvai, Ati-parich-cham (*Tam.*).

History, Uses, &c.—The seeds have long been in repute with Hindu physicians on account of their acrid and stimulating

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properties, and are called in Sanskrit Vanhiruchi, Kanguni, Katumbhi and Jyotishmati, the last synonym meaning "light-possessing," is an allusion to their supposed property of stimulating the intellectual powers (बुद्धि) and sharpening the memory (स्मृति). There is a treatise called *Jyotishmati Kalpa* in which is given the method of extracting the oil from the seeds, either by laying them on the blade of a sword and exposing them to the rays of the sun, or by the action of heat over the fire. This oil is used in the Courts and Colleges of India by a great many pundits to increase the intelligence of their pupils. The Mahometans recapitulate in their works on Materia Medica with some additions what the Hindus say about the drug.

The seeds are thought to be hot and dry, aphrodisiacal, and stimulant, useful both as an external and internal remedy in rheumatism, gout, paralysis, leprosy, and other disorders which are supposed to be caused by cold humours. They may be administered in such cases commencing with a dose of one seed to be gradually increased to fifty by daily increments of one, at the same time the oil may be applied externally, or the crushed seeds combined with aromatics. The latter application is said to be very efficient in removing local pains of a rheumatic or malarious nature. Another preparation for internal administration is made by placing the seeds with benzoin, cloves, nutmegs, and mace into a perforated earthen pot, and then obtaining by distillation into another pot into which it is fitted a black empyreumatic oil. This substance was brought to notice by Herklots as a remedy in Beri-beri under the name of *oleum nigrum*. In doses of from 10 to 15 drops twice a day it acts as a powerful stimulant, and generally produces free diaphoresis. In the Concan 4 tolás of the leaf-juice are given as an antidote in overdoses of opium, and the seeds made into a paste with cow's urine are applied to cure scabies.

Description.—The fruit is a 3-celled, globose green capsule, containing from 3 to 6 seeds enclosed in a complete arillus of a rich orange colour and sweet taste ; the seeds are about the size of millet, of a reddish-brown colour, oily, and

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angular like the section of a sphere; the testa is hard, and the kernel which is white has an acrid taste. The expressed oil (sometimes called staff tree oil) has a deep reddish-yellow colour, apparenty derived from the adhering arillus; it deposits a quantity of solid fat after it has been kept for a short time.

Chemical composition.—The powdered seeds exhausted with ether afford 30 per cent. of a thick reddish, bitter oil with aromatic odour. The bitter principle is insoluble both in cold and boiling water, but is readily extracted from the seeds with proof spirit. Ether extracts it together with the oil, and it may be separated by shaking the oil with 85 per cent. alcohol. The bitter principle is of a resinous nature, similar to a glucosidal resin. A small quantity of a tannin giving a greenish colour with ferric salts is present. The ash amounts to 5·8 per cent. of the seeds.

Commerce.—The seeds and expressed oil are always obtainable in the shops. Value, seeds, 2 as. per lb.; oil, Rs. 20 per cwt. The pomatum sold in the bazars under the name of *Maghas-shuddhi* (brain polisher) is probably composed chiefly of this oil.

ELÆODENDRON GLAUCUM, *Pers.*

Fig.—*Wight Ill.* 178, *t.* 71.

Hab.—Hotter parts of India and Ceylon. The bark and leaves.

Vernacular.—Bakra, Chauri, Jamrasi (*Hind.*), Támruj (*Mar.*), Nerija (*Tel.*), Chellupa-maram (*Tam.*).

History, Uses, &c.—According to Dr. Sakharam Arjun, the leaves are called *Bhutapála* by the Marathás, and are used as a fumigatory to rouse women from hysterical syncope, an affection supposed by the Hindus to be due to demoniacal possession. Dried and powdered the leaves act as a sternutatory, and are used to relieve headache. Roxburgh says:—"The fresh bark of the root, rubbed with plain water, is by the natives applied externally to remove almost every sort of swelling. It

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is a very strong astringent, possessing scarcely any other sensible quality." In the Calcutta Exhibition Catalogue of 1883-84, it is stated that the root is a specific against snakebite, and the bark is used in native medicine and said to be a virulent poison. From experiments we have made there would appear to be no grounds whatever for the statement that the plant is poisonous: as stated by Roxburgh its most remarkable property is astringency.

Description.—Leaves opposite, sharp-petioled, oblong and cuneate-oblong, sometimes very acutely, and sometimes obtusely serrate; texture hard, with both surfaces polished, the upper shining; apex rather obtuse, and always bent down, from 3 to 4 inches long, and about 2 broad. The root bark is compact and brittle, and has a granular fracture; it occurs in small irregular fragments, is of a dull reddish colour, and is covered by a scabrous brittle suber, the external surface of which is brown or sometimes yellowish, and the substance and internal surface of a bright brick red. Some pieces of the bark show small warty prominences which are usually fissured exposing the brick red colour of the suber.

Both leaves and bark are astringent to the taste and slightly bitter. The microscope shows that the bark is loaded with large rhomboid crystals, which are chiefly deposited along the course of the vascular canals; the red colouring matter is mostly contained in separate cells, only a few stone cells are present, the friable nature of the bark is therefore due to the large crystalline deposit.

Chemical composition.—Elæodendron bark contains an alkaloid separable by lime and chloroform, which gives a purplish colour with sulphuric acid, and yellow with nitric acid. The alkaloid was in the bark in combination soluble in water, forming a crystalline salt when evaporated. Two resins were found, one soluble in ether and warm amylic alcohol, the other in rectified spirit. The bark afforded 8 per cent. of tannin, giving a dark green colour with ferric salts, and 5·25 per cent. of glucose. The air-dried bark had 6·98 per cent. of moisture, and gave as much as 18·15 per cent. of white ash when burnt.

More than four-fifths of the ash consist of calcium carbonate, mostly from the reduced calcium oxalate.

EUONYMUS CRENULATUS, *Wall.*

Fig.—*Wight, Ic. t.* 973; *Bedd., Fl. Sylv. t.* 144.

Hab.—Western Peninsula, Nilgiri hills.

EUONYMUS PENDULUS, *Wall.*

Hab.—Temperate Himalaya, East Bengal.

EUONYMUS TINGENS, *Wall.*

Hab.—Western Temperate Himalaya.

Vernacular.—Bárphali, Sikhi, Rangchúl, Guli, Pápar, Chopra, Kunku, Késari (*Hind.*). These names are applied indiscriminately to several Himalayan species.

History, Uses, &c.—The genus Euonymus consists of about forty species, most of which are natives of the tropical regions of Asia and the Malay Archipelago, but a few are scattered over Europe and America. A shrub called ἐυώνυμος is mentioned by Theophrastus (*H. P.* 3; 18, 13), also by Pliny (13, 38); it was reputed to be poisonous, and to cause purging and vomiting. Matthiolus (*Valgr. V., i.,* 173, *f.*) identifies it with *Euonymus europæus,* and Gerarde calls the same plant *E. Theophrasti.* In English it is called Dogwood, Prickwood, Skewerwood, or Spindlewood; the French call it Fusain and the Germans Spindelbaum. The generic name, which in Greek signifies "of good repute," is applied to this genus by antiphrasis. The fruit of *E. europæus* is sometimes used in Europe to destroy lice. A drug called *Euonymin,* prepared by precipitating a concentrated tincture of the bark of *E. atropurpureus* with water, was first introduced by the Eclectic physicians of America. Griffith (*Med. Botany*) states that *E. americanus, E. europæus, E. atropurpureus* and several other species have similar properties, being all nauseous, purgative and emetic.

The numerous species of *Euonymus* which are common in the mountainous districts of India do not appear to be used as a purgative by the Hindus, neither does it appear that their medicinal properties have been investigated by European physicians resident in India.

According to Rutherford (*Phys. action of drugs on the secretion of Bile*, 1880, p. 45), 5 grains of Euonymin mixed with a small quantity of boiling water and placed in the duodenum of dogs, powerfully stimulated the liver; in these animals it only slightly increases the intestinal secretion, but in man it is an active purgative. Its action on dogs was found to be almost identical with that of podophyllin. The usual dose as a purgative is two grains at night, followed by a saline purge in the morning, which according to Rutherford should be sulphate of sodium.

The inner portion of the bark of *E. tingens* is of a fine yellow colour, and is used by the Hindus to make sectarial marks on the forehead. It is also used like *Mámirán* to subdue inflammation of the eyes. The wood of all the species is hard and close-grained, and is used for carving spoons and other small articles. The vernacular name *Kunku* refers to the colour of the arillus so remarkable in plants of this order. Kunku is the red substance used to make the small, round, red spot on the forehead, without which the toilet of a Hindu belle would be incomplete.

Description.—The bark of *E. crenulatus* is almost white when fresh, but acquires a pinkish-brown colour on drying; the external surface is covered by a thin suber, and marked with numerous minute transverse lenticels; on the removal of the suber a chocolate-coloured surface is exposed, marked with similar lenticels of a pale colour. The bark breaks with a short fracture and has a close waxy texture; ferric chloride stains it dirty green. It is slightly astringent and not bitter. The outer surface of the bark from the larger branches of *E. pendulus* is grey and fissured in every direction; when this is removed an inner suberous coat of a bright yellow ochre colour is exposed. The woody inner bark is of a pale chocolate colour and of close waxy texture,

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its inner surface is almost white when fresh, but when dry of a pale cinnamon colour. The taste is astringent; ferric chloride stains it a dirty green.

Chemical composition.—The tincture of the bark of *E. crenulatus* is of an olive-green colour, and produces a turbidity when poured into water. The tincture evaporated to dryness and treated with water, gives a soluble portion containing tannin, a sugar, but no alkaloidal body. It precipitates with ferric chloride dirty green, and with gelatine and plumbic acetate, but not with iodine or potassio-mercuric iodide. This extract evaporated to dryness affords white transparent rhombic crystals. The resinous portion insoluble in water is of a green colour, tasteless, and amorphous, soluble in ether, but imperfectly so in alkalies and alkaline carbonates. The aqueous solution contains gum, and when evaporated is highly crystalline, probably from the presence of mannite, or other saccharine substance.

The bark of *E. pendulus* is, in composition, very much like that of *E. crenulatus*. The young bark gives a green tincture with spirit, and the older bark a red tincture; in each case on dissipating most of the alcohol and treating with water a greenish yellow resinous substance falls, and a bright red liquid remains. The resins are soluble in ether and partly in alkalies, and the red astringent supernatant liquor consists of tannin, giving a murky green colour with ferric chloride, and a quantity of saccharine matter. No bitterness was perceived in the extract, and nothing alkaloidal was detected. The aqueous extract of the drug, after exhaustion with spirit, contained a large quantity of a white, neutral crystalline body, which was dissolved by hot alcohol and crystallised out on cooling. The bark had no marked smell or taste, and afforded a light buff-coloured powder. The powder treated directly with rectified spirit gave 45·5 per cent. of extract, and when burnt left 12·8 per cent. of carbonated ash.

RHAMNEÆ.

ZIZYPHUS VULGARIS, *Lam.*

Fig.—*Sibth. Fl. Græc. I.* 159, *t.* 241. Jujube (*Eng.*), Jujubier (*Fr.*).

Hab.—N. India, Persia, China. The dried fruit.

Vernacular.—Unnáb (*Arab., Ind.*), Sinjid-i-jiláni (*Pers.*).

History, Uses, &c.—This is the Jujube of Arabic and Persian works on Materia Medica, and is largely imported in a dry state both from the Persian Gulf and China. Mir Mohammad Husain describes it as "the fruit of a well-known tree of nearly the same size as the kunár* and olive, but having leaves a little thicker and longer than those of the kunár, with one side downy. The bark, wood and fruit of the tree are red. The best fruit comes from Jurjan, China and Nipal; it should be sweet and moderately astringent, about the size of a dried date and with a small stone." He gives a long account of the medicinal virtues of the Jujube, from which we gather that he regards it as a suppurative, expectorant, and purifier of the blood. Pliny (15, 14,) mentions Zizyphus as an exotic fruit coming from Syria, more like a berry than an apple. Sibthorp informs us that it is called in modern Greek *παλίουρί,* and is probably the *παλίουρος* of Dioscorides.† The bark of the tree is used to clean wounds and sores, the gum in certain affections of the eyes, and the leaves when chewed are said to destroy the power of the tongue to appreciate the taste of disagreeable medicines. The French prepare a Pâté de jujubes by extracting 5 parts of jujubes in sufficient water to obtain 35 parts of infusion, in which are dissolved gum Arabic 30 parts and sugar 20 parts; the solution is evaporated, two parts of orange flower water added, kept slowly boiling for twelve hours, and then poured into moulds.

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* Kunar or K[illegible]nar, *Zizyphus Jujuba*, or wild Jujube, a generative tree of Persia from which the first spark of fire was obtained. (*Bundehesh, cap.* 15.)

† Dios. I., 106.

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In India we have also several cultivated varieties of **Z. Jujuba** (*Sans.* Vadari or Badari, Dviparni and Vanakoli) which afford edible fruit, as well as a wild variety; their bark is powerfully astringent, and a kind of lac, known as *Bori-lák*, is found upon them. The fruit is dried and powdered; this powder is called in Hindi *Ber-chuni*, and is used as an article of diet. The young leaves are pounded with those of *Ficus glomerata*, and applied to scorpion stings; they are also with *Acacia Catechu* leaves given as a cooling medicine in hot weather in doses of two tolás (360 grains). According to Ainslie, the root is prescribed in decoction by the Vytians in conjunction with sundry warm seeds, as a drink in certain cases of fever.

The white pear-shaped fruit of **Z. rugosa** (Turan) is eaten by the natives, and the bark is used as an astringent in diarrhœa. The fruit of **Z. xylopyra** is used by shoe-makers for blackening leather and for making blacking. The flowers of **Z. rugosa**, with an equal quantity of the petioles of the Betel leaf, and half as much lime, are given in 4-grain pills twice a day for menorrhagia.

Description.—The dried fruit which comes from China is from 1 to 1½ inch long and ¾ inch broad; skin red, much shrivelled; pulp adherent to the stone, spongy, sweet and yellow; stone 7-10th inch long, very hard and rugose, apex sharp-pointed; shell very thick; seed oblong, flat, of a chestnut colour, 4-10th inch long and 2-10th broad. The fruit which comes from the Persian Gulf is somewhat smaller.

Chemical composition.—Jujubes contain mucilage and sugar. The bark and leaves contain tannin. The watery extract of the wood contains a crystallizable principle (ziziphic acid), a tannin (ziziphotannic acid) and a little sugar. (*Latour.*)

Commerce.—The Indian market is supplied from China and the Persian Gulf ports. The Chinese fruit is preferred, as it is larger and sweeter. Value, Chinese, Rs. 8 per Surat maund of 37½ lbs.; Arabian, Rs. 4—5.

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RHAMNUS WIGHTII, *W. & A.*

Fig.—*Wight Ic., t.* 159.

Hab.—Western Peninsula, Concan to Nilgiris. The bark.

Vernacular.—Raktarohida, Ragatrora (*Mar.*).

History, Uses, &c.—We have not been able to identify this drug with any of those mentioned in native works on Materia Medica. The name Raktarohida or Raktrora, "red Rohita," appears properly to belong to *Amoora Rohituka*, but it is applied popularly to several astringent drugs. *R. Wightii* is a common shrub upon the highest hills of the Western ghauts, and extends to the Nilgiris and Ceylon; the leaves are glabrous, sub-opposite, elliptic, shortly acuminate, sharply serrate, and sub-coriaceous. Pedicels axillary, fascicled, much shorter than the petiole; calyx 5-cleft; petals cuneate-obovate; flowers greenish-yellow; styles 3—4, diverging; ovary 3—4, celled. Gibson states that the bark is in much repute on account of its tonic, astringent and deobstruent properties. (*Bombay Flora.*) A liquid extract of this bark has been given by Dr. J. North in half dram to two dram doses to a number of natives without experiencing either any astringent or aperient effect; the larger dose produced no nausea, and it appeared to have only some slight tonic action. It is brought to Bombay by herbalists and sold to the shopkeepers.

Description.—The dried bark occurs as single quills or in curved pieces from 2 to 3 millimetres in thickness. The outer surface is dull brown in colour, beset with numerous corky protuberances or lenticels opening longitudinally, and sometimes closely covered with whitish or greenish lichen. The younger bark is ashy-grey with fewer lenticels; the older bark presents a more rugged surface, due to the growth of cork and the occurrence of deep transverse cracks, and is much thicker. The outer surface of the middle layer is reddish-brown, and exhibits indentations and transverse markings corresponding with the warts and cracks of the exterior layer. The

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inner layers consist of pale liber fibres running through a mass of cells containing yellowish-brown colouring matter of a waxy consistence. The inner surface is dark chocolate-brown, becoming almost black when kept for some weeks. The fracture is short externally, and tough and fibrous internally. A section touched with a drop of potash solution becomes intensely red, with ferric chloride dirty green, and with iodine solution black. The taste is astringent and bitter, but not unpleasant, a sweetish after-taste being left on the palate. The odour of the bark recalls that of tan.

Microscopic structure.—A microscopic examination shows that throughout the parenchyma, especially of the mesophlœum, there are a number of aggregate crystals, more plentiful in older specimens. The mesophlœum contains many thick-walled cells. The medullary rays and inner cellular layers are filled with starch granules. A yellow colouring matter, residing principally in the liber and cambium, becomes brilliantly red in contact with potash solution. In the cells surrounding the liber vessels, are numerous large rhomboidal crystals.

Chemical composition.—The bark has been examined by D. Hooper (*Pharm. Journ.*, Feb. 1888), with the following results:—

Crystalline principle	0·47
Light brown resin soluble in ether ...	0·85
Red resin soluble in ether	1·15
Red acid resin soluble in alcohol	4·56
Indifferent α—resin sol. in alcohol ...	3·80
Indifferent β—resin sol. in alcohol ...	1·64
Tannin	2·68
Bitter principle	1·23
Sugar reducing	2·20
Sugar non-reducing	10·12
Malic acid (?)	0·89
Cathartic acid	4·42
Extractive soluble in water	0·65
Albuminous matter	6·67
Modification of arabin sol. in alkali ...	1·75

Calcium oxalate	7·43
Starch	7·83
Modification of arabin sol. in acid	5·54
Cellulose	16·17
Suberin, &c.	6·38
Lignin	9·80
Ash (balance of)	3·39
Moisture and loss	0·38
	100·00

The ash gave the following analysis:—

Insoluble silica	1·48
Soluble silica	0·18
Iron and alumina	1·55
Lime	47·04
Magnesia	2·91
Carbonic anhydride	35·52
Phosphoric anhydride	1·78
Sulphuric anhydride	0·68
Chlorine	trace
Alkalies, &c., by difference	8·86
	100·00

Mr. Hooper remarks that the crystalline body found in the ethereal extract appeared under the microscope as white transparent prisms, and was sparingly soluble in water, ether, alcohol, and boiling bisulphide of carbon. When freed from adherent resin, it was not coloured by strong sulphuric acid or potash solution, the crystals melted and partly sublimed when heated, leaving a deposit of carbon. It had similar reactions with the "crystallizable body" obtained by Prescott[*] from *Cascara Sagrada*. The light brown resin was soluble in rectified spirit, and gave a fine rose colour with diluted alkalies. When heated it melted to a reddish mass, and gave off greenish-yellow vapour, which sublimed and had similar characters to the original resin. It was semi-crystalline when observed under the microscope.

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The red resin soluble in ether gave a fine purplish-red with alkalies, and was totally precipitated from solution by acids. It gave a crimson colour fading to a yellow, and dissolved in concentrated sulphuric acid. With nitric acid it became an orange-brown solution, and was precipitated on the addition of water. It was quite tasteless, and had no crystalline structure when evaporated from different solvents.

The red acid resin soluble in alcohol constituted the larger part of the resins present. It differed from the resins soluble in ether by its rapid decolorization and removal from solutions when shaken with animal charcoal. It is coloured deep red-brown with potash, and is at once thrown down when neutralized with acids.

The α-resin appears to be changed by heat and acids into the red resin soluble in alcohol. The β-resin is known by its insolubility in ammonia and fixed alkalies, but it affords red solutions with strong nitric and sulphuric acids. It has a brown colour which changes to green on exposure to the air. It resembles "the light yellow resin or natural body" found by Prescott in the bark of *Cascara Sagrada.*

VENTILAGO MADRASPATANA, *Gärtn.*

Fig.—*Wight Ic. t.* 163; *Gärtn. Fruct. I.* 223, *t.* 49, *f.* 2.

Hab.—Southern India, Ceylon, Burma. The root bark.

Vernacular.—Khándvel, Lokhandi (*Mar.*), Vembádam (*Tam.*), Popli-chukai (*Can.*), Súrúghúndu-putta (*Tel.*).

History, Uses, &c.—Vembádam bark has long been used in Madras and Mysore as the source of a reddish brown dye, the tint of which is fixed by means of *kadukai* (chebulic myrobalans) and *paddicarum* (alum). Ainslie states that the powdered bark mixed with gingelly oil is sometimes used as an external application for the itch and other cutaneous eruptions. He gives Raktavalli, "red creeper," as the Sanskrit name.

The bark of the stem serves as cordage, and the natives of Amboyna make ropes of it. Buchanan frequently mentions the dye under the name of *Popli,* and places it amongst the forest products of Mysore. (ii. 305.)

Description.—The Ventilago is a large scandent shrub, and reaches to the top of the highest trees in the forests where it grows. The leaves are ovate, acuminate, coriaceous and shining, and the flowers are in slender spikes. The fruit is samaroid, from 1½ to 2 inches long, and ⅔ inch broad; the nut is about the size of a pea, girt at the base by the remains of the calyx forming a disc. The roots are from ½ to 1 inch in diameter, and rough with reddish loose scales. The drug consists of the root bark in scales made up of numerous papyraceous layers of a deep reddish brown colour, and in some of the older pieces, with a metallic lustre. Vembádam bark gives up a red colour to water, and an intense reddish brown colour to rectified spirit; by being heated together the colouring matter is communicated to certain fats and fixed oils, and it is taken up by volatile oils even in the cold.

Chemical composition.—By treating the drug with water a liquor is obtained of red colour and slight acid reaction, giving violet red precipitates with lead acetate, calcium and barium hydrates, a rose-tinted lake with alum and potassium carbonate, and muddy mixtures with ferrous and ferric salts. The alcoholic solution is more acid in reaction, and does not precipitate with alcoholic lead acetate; the colour is removed from solution by means of animal charcoal, but not by heating with zinc dust. Evaporated carefully to dryness no crystals were observed, and the red mass re-dissolved in chloroform, benzol and carbon disulphide, and in alkaline solutions with a magenta hue, which was discharged by acids. This colouring matter is of an acid nature, and is probably one of the derivatives of anthracene.

Commerce.—Vembádam bark is collected extensively on the northern slopes of the Nilgiris. In the Annual Report of the Madras Forest Department for 1887-88, it appears that 3 tons were collected, which realized a revenue of Rs. 62, the value of the permits. During the year 1888-89, 41 maund of 1st class bark and 66 maunds of 2nd class bark were collected and sold by Government agency at Rs. 2 and Rs. 1-8 per maund respectively.

AMPELIDEÆ.

VITIS VINIFERA, *Linn.*

Fig.—*Bentl. & Trim.*, *t.* 66. The Vine (*Eng.*), Vigne cultivée (*Fr.*)

Hab.—N.-W. Himalayas. Cultivated elsewhere. Grapes and raisins.

Vernacular.—Angur, Dákh (*Hind.*), Drákh (*Guz.*), Dráksha (*Mar.*), Dirakhsha-pazham (*Tam.*), Dráksha-pandu (*Tel.*), Drakshi-hannu (*Can.*), Drákhyá (*Beng.*). Raisins, Kishmish, Munakha (*Pers., Ind.*).

History, Uses, &c.—The cultivation of the Vine is of great antiquity. Noah planted a vineyard, and by drinking of the wine was made drunk. The wife of Jamshid tried to poison herself by drinking the juice of grapes, but the effects produced were such as to induce others to taste the poison. Hesiod gives directions for pruning the vine. According to Greek tradition, Dionysus taught all nations to cultivate the vine and to drink wine The Dionysus of the Greeks and the Indra of the Hindus are symbolical of the productive, overflowing, and intoxicating power of nature which often carries man away from his usual quiet and sober mode of living. The Soma of the Hindus and the original wine of Greek tradition was doubtless the celestial Amrita or Ambrosia. Grapes, in Sanskrit Draksha, are noticed by Susruta and Charaka; in the dried state they were used in medicine on account of their demulcent, laxative and cooling properties. It would also appear that a spirituous preparation was made from them, and was used as a stimulant under the name of Dráksha arishta, the receipt for making which is as follows:—Raisins, 12½ lbs., water 256 lbs., boil together until reduced to one-fourth and

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strain; then add, treacle 50 lbs., cinnamon, cardamoms, folia malabathri, flowers of *Mesua ferrea*, fruit of *Aglaia Roxburghiana*, black pepper, long pepper and seeds of *Embelia Ribes*, all in fine powder, of each 2¾ ozs., and set aside for fermentation. Grapes are described by Dioscorides under the name of *σταφυλη*; he also notices raisins (*σταφίς*) and their medicinal properties.* Pliny speaks of *Uvæ*, grapes, and *Acini passi*, raisins.† The τρὺξ ὄινου of the Greeks, *Fœx vini* in Latin, is our Argol; the *Milh-el-tartír* of the Arabs. Mahometan writers consider grapes and raisins to be attenuant, suppurative and pectoral; the most digestible of fruit, purifying the blood and increasing its quantity and quality; they say that they are more wholesome if kept a few days after being gathered, and that the skin and stones should not be eaten. The ashes of the wood are recommended as a preventive of stone in the bladder, cold swellings of the testes, and piles; in the two last named diseases they are to be applied externally as well as given internally. The juice of unripe grapes, *Husrum* (Arab.), *Ghúreh* (Pers.), is used as an astringent; it is the ὀμφάκιον of Dioscorides, our Verjuice, and the *Agresto* of the modern Italians, who still use it in affections of the throat. The cut branches of the vine yield in spring an abundant sap, which was formerly used as a remedy for skin diseases, and is still a popular remedy in Europe for ophthalmia.

Extractum pampinorum vitis, which is used in some European countries as an astringent, diuretic, nervine and antispasmodic, and also to remove freckles, is made by evaporating the expressed juice of the young buds of the vine, exhausting the extract with alcohol, and again evaporating.

Grape marcs calcined in a closed vessel yield a fine black charcoal known as *Noir de Francfort*.

Different kinds of wine are used in medicine and pharmacy. The physiological action of wine upon the system is in some respects similar to that of alcohol, small doses being stimulant and large doses narcotic. Wine has also secondary medicinal

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* Dios. V., 3.

† Plin. 14, 1, *et seq*.

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effects which vary in different wines. Light white wines are diuretic, and red tonic and astringent. Taken in moderate quantity at meals, wine increases the heat of the body, aids nutrition, stimulates the functions of the different organs, and promotes the play of the imagination.

In making medicinal wines, a rich sweet wine should be used for the preservation of changeable drugs, red wines for tonic and astringent substances, and white wines for diuretic medicines. (*Dorvault.*)

Description.—The ovary of *Vitis vinifera* is 2-celled, with two ovules in each cell; it developes into a succulent, pedicellate berry of spherical or ovoid form, in which the cells are obliterated and some of the seeds generally abortive. As the fruit is not articulated with the rachis, or the rachis with the branch, it does not drop at maturity, but remains attached to the plant on which, provided there is sufficient solar heat, it gradually withers and dries: such fruits are called raisins of the sun. (*Hanbury.*)

Miscroscopic structure.—The outer layer or skin of the berry is made up of small tabular cells loaded with a reddish granular matter, which on addition of an alcoholic solution of perchloride of iron assumes a dingy green hue. The interior parenchyme exhibits large, thin walled, loose cells containing an abundance of crystals (bitartrate of potassium and sugar). There are also some fibro-vascular bundles traversing the tissue in no regular order. (*Pharmacographia.*)

Chemical composition.—From the *Pharmacographia* we gather that the pulp abounds in grape sugar and cream of tartar, each of which in old raisins may be found crystallised in nodular masses; it also contains gum and malic acid. The seeds afford 15 to 18 per cent. of a bland fixed oil, which is occasionally extracted, and which becomes thick at —15° C., and congeals to a brownish mass of the consistence of butter at about —16° to —18° C. On exposure to the air the oil remains smeary for some time, but finally dries. (*Brannt.*) Fitz has shown that it consists of the glycerides of erucic acid, $C^{22} H^{42}$

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O^2, stearic acid and palmitic acid, the first named acid largely prevailing. The crystals of erucic acid melt at 34° C.; by means of fused potash they may be resolved into arachic acid, $C^{20} H^{40} O^2$, and acetic acid, $C^2 H^4 O^2$. The seeds further contain 5 to 6 per cent. of tannic acid, which also exists in the skin of the fruit. Wine is of a very complicated composition. In an old red wine, the following substances have been found in 1,000 parts:—Water 878, alcohol, containing traces of butyric and amylic alcohol, several aldehydes, and the *bouquet* composed of acetic, capric, caprylic, and œnanthic ethers, and essential oil 100. Sugar, mannite, glycerine, mucilage, gums, colouring matter or œnolin, fatty matter, nitrogenous matter or ferment, tannin, carbonic acid, acid tartrate of potash, tartrates, racemates, acetates, propionates, butyrates, lactates, citrates, malates, sulphates, nitrates, phosphates, silicates, chlorides, bromides, iodides, fluorides, meconates; potash, soda, lime, magnesia, alumina, oxide of iron, ammonia 22. Pasteur has recorded the presence in all wines of gum combined with phosphate of lime. (*Un. Pharm.*, 1869.) Ludwig that of trimethylamine, and Lebaigne the frequent presence of manganese (*Un. Pharm.*, 1870.)

G. Baumert has found that boric acid is contained in German, French, and Spanish wines, and in the leaves and tendrils of the grape vine. (*Ber.* 21, 3290.)

The aroma or *bouquet* of wines is due to certain essential oils, specially belonging to each kind; the vinous odour is due to an oil or ethereal principle which has been isolated by Liebig and Pelouze and named œnanthic ether. This oil, which exists only in small quantity, appears to be formed during fermentation. Fauré thinks it is derived from the skin of the ripe fruit. Berthelot has isolated the bouquet by shaking the wine in a vessel of carbonic acid gas with ether freed from air by passing carbonic acid gas through it. The ether on evaporation in a current of carbonic acid gas gives an extract possessing the vinous odour and peculiar bouquet of the wine. (*Dorvault.*)

The average percentages of alcohol in the wines most used in India are :—Marsala, 17·91 ; Madeira, 20·48 ; Port, 20·00 ; Sherry, 17·63 ; Malaga, 15·00 ; Sauterne, 15·00 ; Burgundy, 13·40 ; Champagne, 11·60 to 12·77 ; Red Bordeaux, 8—11·00.

According to J. König and C. Kranch, Black raisins contain : Water 23·18, Albuminous matter 2·72, Fat 0·66, Grape sugar 55·62, Other non-nitrogenous matter 14·12, Cellulose 1·94, Ash 1·36. In the dry substance they found Nitrogen 0·56, Sugar 72·43 per cent. Sultana raisins examined by E. Mach and K. Portele yielded—Water 20·4, Dextrose 30·2, Levulose 36·4, Pectin 1·86, Free acids 1·76, Malic acid 0·38, Argol 3·28, Insoluble matter 5·0, Ash 2·03. In the dry substance the total sugar amounted to 83·66 per cent. (*König, Nahrungs-mittel.*)

The leaves of the vine gathered in the early summer contain, according to M. C. Neubaur, tartaric acid, bitartrate of potash, quercetin, quercitrin, tannin, starch, malic acid, gum, inosite, uncrystallizable sugar, oxalates of lime and ammonia, and phosphate and sulphate of lime. In autumn the leaves contain much more quercetin and only a trace of quercitrin. Inosite and malic acid are no longer present.

Commerce.—Grapes are produced in most parts of the table land of India, along the coast the climate is too moist for vine cultivation. A very superior half-dried grape, resembling those sold in Europe, is brought from Cabul packed in chip boxes. The raisins found here are the Sultanas from Cabul and Persia, some of which, very large and of a pale greenish yellow colour, are called *Angul Drákh* ; the black bloom raisins (*Kálá Drákh*) from the same countries, which are used for medicinal purposes ; and an inferior kind, called *Munakha*, like the pudding raisins sold in England.

Value, Indian grapes, 2 to 4 annas per lb. ; Cabul, 4 annas per box, containing about 100 grapes.

Raisins, Cabul and Persian, Rs. 5 to 7 per Surat maund of 37½ lbs. ; Bloom, Rs 5 ; Munakha, Rs 3 ; Angul Drákh, Rs 6¼.

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VITIS QUADRANGULARIS, *Wal*

Fig.—*Wight Ic.*, *t.* 51; *Rheede, Hort. Mal. vii.*, *t.* 41. Vigne et Raisins de Galam (*Fr.*).

Hab.—India, Arabia. The stalk and leaves.

Vernacular.—Harsȧnkar, Harjora, Nallar (*Hind.*), Pirandai (*Tam.*), Nalleru (*Tel.*), Horjora (*Beng.*), Mangaruli (*Can.*), Chaudhári-kandvel (*Mar.*), Chodhári, Harsankar (*Guz.*).

History, Uses, &c.—This is the Ashti-sandhana of Sanskrit writers. The leaves and stalks when young are sometimes used as a vegetable, when older they become acrid and are thought to have medicinal properties. Ainslie says that when dried and powdered they are prescribed by the Tamool practitioners in certain bowel affections connected with indigestion; they are also considered as powerful alteratives; of the powder about two scruples may be given twice daily in a little rice water. Forskahl states that the Arabs when suffering from affections of the spine make beds of the stems.

The juice of the stem is dropped into the ear in otorrhœa, and into the nose in epistaxis; it has also a reputation in scurvy, and in irregular menstruation; in the latter disease, 2 tolás of the juice, extracted by heating the plant, is mixed with 2 tolás of ghi and 1 tolá each of Gopichandan (a white clay) and sugar, and given daily.

Description.—A climbing glabrous plant with fibrous roots; stem 4-angled, winged; stipules lunate entire; leaves very thick and fleshy, alternate, generally 3-lobed, cordate-ovate, serrulated, short petioled; umbels shortly peduncled; stamens 4; petals 4, distinct; fruit globose, size of a large pea, very acrid, one-celled, one-seeded; seed solitary, obovate and covered with a dark brown spongy integument; flowers small, white, appear at the end of the rainy season.

VITIS INDICA, *Linn.*

Fig.—*Rheede, Hort. Mal. vii.*, 6. Indian Wild Vine (*Eng.*), Vigne d'Inde (*Fr.*), Uvas dos bugios (*Port.*).

Hab.—Western Peninsula. The tubers.

Vernacular.—Amdhuka (*Hind.*), Amoluka (*Beng.*), Rán-dráksha, Kole-ján (*Mar.*), Sambara-valli (*Tel.*).

History, Uses, &c.—This is a large climbing plant, with perennial tuberous roots; the fruit and leaves as well as the whole appearance of the plant remind one of the Vine. Rheede says that the juice of the root with that of the kernel of the cocoanut is used as a depurative and aperient. The country folk in the Concan also use it as an alterative in the form of a decoction; they consider that it purifies the blood, acts as a diuretic, and renders the secretions healthy. The tubers of **V. latifolia,** Govila (*Beng.*), *Rheede, Hort. Mal. vii.*, 13, *t.* 7, are used for a similar purpose.

Description.—The roots form large bunches of tubers attached to a central root stock; the tubers are from one to two feet long, tapering at both ends, with a maximum diameter, when fresh, of from two to three inches; externally they are covered by a brown epidermis, and marked with small wart-like protuberances arranged in circular rings; internally they are red and juicy. A section shows a thick stringy cortical portion easily separable, and a central fleshy part of the consistence of a parsnip. Under the microscope the root is seen to be made of a thin-walled parenchyma, the cells of which contain large oblong starch granules, and numerous bundles of needle-shaped crystals; the outer portion of the root and root bark is traversed by numerous very large fenestrated vessels. The taste is sweetish, mucilaginous and astringent. The tubers are rich in salts of potash and lime. When fresh they are acrid, owing to the mechanical irritation caused by the needles of oxalate of lime.

LEEA SAMBUCINA, *Willd.*

Fig.—*Rheede, Hort. Mal. ii.*, 26.; *Wight, Ic. t.* 78; *Illus., t.* 58. Syn.—*Leea Staphylea*, Roxb.

Hab.—Hotter parts of India. The roots.

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Vernacular.—Kurkur-jihwa (*Beng.*, *Hind.*), Ankados (*Tel.*), Karkani (*Mar.*), Dino (*Goa.*).

History, Uses, &c.—This plant is the Nálugu of Rheede, who gives Dino as the Brahminic name, and says that a decoction of the root is given in colic, and that it is cooling and relieves thirst.

The roasted leaves are applied to the head in vertigo; the juice of the young leaves is digestive. In Goa it is called Dino by the natives and Ratanhia by the Portuguese, and is much used in diarrhœa and chronic dysentery. In Réunion the root is called *Bois de Sureau*, and is said to be used as a sudorific.

Description.—Stems shrubby, with straight branches, leaves pinnate or tripinnate, often 3½ by 4 feet, leaflets stalked, very variable in size and shape, nerves arcuate; flowers greenish-white, anthers connate. Fruit the size of a small cherry, dry. Grows in patches in thick jungle, looking something like Elder. The root is woody, porous and tough, and covered with a striated, dark brown slightly scabrous bark, the internal surface of which is of a deep red colour. The bark has an astringent and rather agreeable flavour; the wood appears to be inert.

Leea macrophylla, *Roxb.*, *Wight Ic.*, *t.* 1154; *Griff*, *Ic. Pl. As* 645, *f.* 1. Dinda (*Mar.*), Dholsa-mudra (*Beng.*), Dholasa-mudrika (*Sans.*), is a native of the hotter parts of India. The tuberous root is employed in the cure of Guinea-worm, and when pounded is applied to obstinate sores to promote cicatrization; according to Roxburgh the root is astringent and a reputed remedy for ringworm. The young shoots are eaten as a vegetable.

Description.—Stem herbaceous, erect, flexuose jointed; leaves very large, simple, broad cordate, toothed, smooth on both sides; cymes terminal, large; flowers numerous, small, white; berry depressed, size of a small cherry, smooth, black and succulent when ripe; root tuberous. The tubers are of a

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deep red colour, 3 to 6 inches long, and 1 to 2 inches in diameter; they are very mucilaginous and astringent. The tubers of *Leea crispa*, Wild., are also used as a remedy for Guinea-worm, and are said to be more efficient than those of *L. macrophylla*. *Leea hirta*, Roxb. (Kákajangha), is also used medicinally.

The plants of minor importance belonging to the Ampelideæ are:—

Vitis setosa, *Wall., Wight Ic. t.* 170; *Vernacular*—Harmal (*Hind.*), Bara-butsali (*Tel.*), Puli-naravi (*Tam.*), Khájgoli-cha-vel (*Mar.*), an acrid plant sometimes applied as a domestic remedy to promote suppuration and assist in the extraction of Guinea-worms.

Vitis carnosa, *Wall., Wight Ic. t.* 171; *Vernacular*—Amal-bel, Gidar-drak, Kassar (*Hind.*), Kanapa-tige (*Tel.*), Mekamettavi-chettu (*Tam.*), Odi, Ambat-vel (*Mar.*), Khatumbro (*Guz.*), Amal-lata (*Beng.*), Fleshy wild Vine (*Eng.*), used as a domestic application to boils.

Vitis pedata, *Vahl., Rheede Hort. Mal. vii.*, 10, Godhápadi or Iguana's foot in Sanskrit, from a fancied resemblance of the leaves to the foot of that reptile; *Vernacular*—Goali-lata (*Beng.*), Gorpadvel (*Mar.*), used as a domestic remedy on account of its astringency.

Vitis araneosus, *Dalz., Vernacular*—Bendri, Bendervel, Ghorvel (*Mar.*), Kamràj (*Hind.*). The tuberous roots are sold by herbalists as *Chamár-musli,* and used as an astringent medicine. It is called Ghorvel or "Horse vine," from the practice in Western India of giving the young shoots and leaves to horses once a year as a kind of cooling medicine.

Under the names of **Shamraj** and **Bhojraj** short pieces of the stems of two species of Vitis are sold by herbalists in the Central Provinces as a remedy for gonorrhœa. They are both very astringent.

Remarks.—The different species of Vitis and Leea are chiefly remarkable for containing a large amount of tannin, they are therefore useful astringents. Some of them are acrid owing

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to the presence in their tissues of needle-shaped crystals of oxalate of lime, which act as a mechanical irritant; as has been shown in the case of the Arums by Pedler and Warden. These acrid plants on being dried lose their acridity from the adhesion together of the bundles of needle-shaped crystals in the plant cells so as to form blunt crystalline masses. The dried tubers and stems can therefore be administered medicinally, and are useful as antacids and diuretics from the large quantity of potash and lime salts which they contain.

SAPINDACEÆ.

CARDIOSPERMUM HALICACABUM,

Linn.

Fig.—*Bot. Mag. t.* 1049; *Griff. Ic. Pl. As. ic., t.* 599, *f.* 3. Heart Pea (*Eng.*), Pois de Marveille, Cœur des Indes (*Fr.*).

Hab.—India. The herb.

Vernacular.—Lataphatkari, Nayáphatkì (*Beng.*), Kána-pháta (*Hind.*), Mooda-cottan (*Tam.*), Bodha, Shib-jal, Kánphuti (*Mar.*), Karodio (*Guz.*), Kánákaia (*Can.*), Vekkudu-tige, Bodha (*Tel.*).

History, Uses, &c.—Sanskrit writers mention this plant under the name of Karna-sphota and Páráváta-padi (pigeon's foot); it also bears the synonym of Jyotishmati (see *Celastrus paniculata*); they describe the root as emetic, laxative, stomachic, and rubefacient; and prescribe it in rheumatism, nervous diseases, piles, &c. The leaves are used in amenorrhœa. The following prescription is given in the Bhavaprakasha. Take the leaves of *C. Halicacabum*, impure carbonate of potash (sariká), acorus calamus root, root bark of *Terminalia tomentosa*, of each equal parts, and reduce to a paste with milk. About a drachm of this compound may be taken daily for three days in amenorrhœa. The juice of the plant is dropped into the ears to cure earache and discharge from the meatus, whence the Sanskrit name Karna-sphota and the Hindi Kánapháta. It is a favourite vegetable with the Arabs and Egyptians, who call it *Taftaf.* In Tenasserim it is much cultivated for the same purpose. Rheede says that on the Malabar Coast the leaves are administered in pulmonic complaints. According to Ainslie, the root is considered aperient, and is given in decoction to the extent of half a teacupful twice daily. It would appear that in rheumatism the Hindus administer the leaves internally rubbed up with castor-oil, and also apply a paste made with them externally: a similar external application is used to reduce swellings and tumours of various kinds. A medicial plant, called ἁλικάκαβος, and in pure Latin *Vesicaria* (Bladderwort), was known to the Greeks and Romans, and had a reputation for the cure of pains in the bladder. (*Confer. Pliny,* 21, 31.) It is generally considered to have been a species of Physalis. *C. Halicacabum* has been thought by some to be the *Abrong* or *Abrugi* of Serapion, who describes it as a round grain spotted with black and white, which is brought from China, having a bitter taste, hot and dry in the second degree, a laxative and vermifuge. We think that there can be little doubt that the Abrong of Serapion is the fruit of *Embelia Ribes,* the Chitra-tandula or "spotted grain" of the Hindus.

Description.—Annual, climbing; stem, petioles and leaves nearly glabrous; leaves biternate; leaflets stalked, oblong, much acuminated, coarsely cut and serrated; flowers small, white or pink; fruit a membranous bladdery capsule, 3-celled, 3-valved; seeds globose, black, with a two-lobed white aril at the base. Roots white and fibrous, with a rather disagreeable odour, and an acrid nauseous and somewhat bitter taste.

Chemical composition.—The plant owes its medicinal properties to the presence of saponin.

SAPINDUS TRIFOLIATUS, *Linn.*

Fig.—*Wight Ill., t.* 51; *Rheede, Hort. Mal. iv.,* 43, *t.* 19. Soapnut tree (*Eng.*), Savonnier á feuilles de Laurier (*Fr.*).

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Vernacular.—Ritha (*Hind.*), Ponnán-kottai (*Tam.*), Ringin, Ritha (*Mar.*), Aritha (*Guz.*), Kunkudu-kayalu (*Tel.*), Antala, Artala (*Can.*).

Hab.—South India, cultivated in Bengal. The fruit.

History, Uses, &c.—The soapnut, in Sanskrit Phenila and Arishta, has probably been in use among the Hindus from the earliest ages as a detergent, and is still used in preference to soap for certain purposes, just as the soapworts were formerly used in the West. Malachias (3) writes: "He is like a refiner's fire and like fuller's *Borith*, &c. In the Septuagint (270 B.C.) Borith is translated 'ποα' and in the Vulgate 'herba'; the old English translation has 'sope.' Malachias' description of the purgation of the sons of Levi is exactly similar to the process to which the Indian goldsmith submits his ornaments. Both Hindus and Mahometans use it medicinally; the latter give it the name of Banduk or Finduk-i-Hindí (Indian Filbert). In the Nighantas it is described as hot, and a preventive of conception. The following account of its properties is extracted from the Makhzan-el-Adwiya:—"The pulp of the fruit is at first sweetish to the taste, afterwards very bitter; it is hot and dry, tonic and alexipharmic; four grains in wine and sherbet cure colic; one miskal rubbed in water until it soaps, and then strained, may be given to people who have been bitten by venomous reptiles, and to those suffering from diarrhœa or cholera. Three or four grains may be given by the nose in all kinds of fits producing insensibility. Fumigations with it are useful in hysteria and melancholy; externally it may be applied made into a plaster with vinegar to the bites of reptiles and to scrofulous swellings. The root is said to be useful as an expectorant. Pessaries made of the kernel of the seed are used to stimulate the uterus in child-birth and amenorrhœa. One miskal of the pulp with one-eighth of a miskal of scammony acts as a good brisk purgative." Rheede describes the tree as anti-arthritic, and says a bath is prepared with the leaves, and the root is administered internally. Ainslie mentions the use of soap-nuts by the Vytians as an expectorant in asthma. In India the pulp of the fruit is given as an anthelmintic in small doses. The bark is astringent. Soap berries are used in France for washing silk dyed with aniline colours. We have no record of the use of this fruit as a poison for human beings, doses of 70 grains and more appear to have no injurious effect upon the system when taken as a purge.

Description.—Berries three, united, when ripe soft, of a yellowish green colour, singly they are of the size of a cherry, somewhat reniform, with a heart-shaped scar on the attached side. When dry they are of the colour of a raisin, skin shrivelled, pulp translucent, absent on the attached side. The inner shell enclosing the seed is thin, tough and translucent like parchment, except at the scar, where it is woody. Seed the same shape as the fruit, black, smooth, except at the hilum, where it is tomentose, size of a large pea; on the upper part of the dorsum of the seed are two shallow diverging furrows; the testa is double, the outer very thick and hard, the inner membranaceous; kernel yellowish green, oily; cotyledons unequal, thick, firm and fleshy, spirally incurvate. Radicle inferior, linear, lodged at the base of the seed, pointing to the lower and inner angle. The pulp of the fruit has a fruity smell; its taste is sweet at first, afterwards very bitter.

Chemical composition.—The saponin, estimated by weighing the sapogenin formed by boiling with dilute acid, amounts to 11·5 per cent.; this result is confirmed by determining the glucose before and after the treatment and calculating the increase of glucose into the glucoside. The weight of the barium and lead precipitates points to a lower percentage of saponin. The fruits yield to water 40 per cent., and to alcohol 15 per cent. of extract. They contain in a ripe state over 10 per cent. of glucose, and a quantity of pectin, which renders the water solution difficult of filtration. Submitted to distillation, the drug afforded a small quantity of what appeared to be butyric acid. According to Braunt no saponin is contained in the woody stone, seed or husk. The thick cotyledons contain about 30 per cent. of a white fat, semi-fluid at 20° C.

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and melting to a clear oil at 30° C., which possesses a somewhat characteristic odour. The oil saponifies readily, and is employed medicinally and in the manufacture of soap.

S. Mukorassi, *Gärtn. Fruct. I.*, 342, *t.* 70, f. 3, *g, h,* is the soapnut of Northern India, and is called *Dodan* in the Punjab.

Commerce.—Soapnuts are brought to market from many parts of the country. Value, Rs. 2½ to Rs. 3 per pharrah (about 35 lbs.).

SCHLEICHERA TRIJUGA, *Willd.*

Fig.—*Bedd., Fl. Sylv. t.* 119; *Rumph., Herb. Amb. I. t.* 57. Ceylon oak (*Eng.*).

Hab.—N.-W. Himalaya, C. and S. India, Burma, Ceylon. The bark and oil.

Vernacular.—Kosimb (*Hind., Mar.*), Pu-maram (*Tam.*), May, Roatangha (*Tel.*), Puvam (*Mal.*), Sagade, Chakota (*Can.*).

History, Uses, &c.—Rumphius and Roxburgh have both noticed this tree. The pulpy subacid aril of the fruit is edible and palatable. The bark is astringent, rubbed up with oil, the natives use it to cure itch and acne. Lac is produced on the young branches. The wood is very hard, strong and durable; sapwood whitish, heartwood light reddish brown. It is used all over the country for oil, rice and sugar mills, and for agricultural implements and carts. The oil, which is used as a lamp oil in India, is reputed to be the original *Macassar oil;* it has recently reappeared in commerce in Germany as Macassar oil, and has been noticed in Messrs. Gehe and Co.'s trade report as a valuable stimulating and cleansing application to the scalp, which promotes the growth of the hair.

Description.—Drupe the size of a nutmeg, a little pointed, with a grey, fragile husk, covered with soft blunt prickles. Seeds one to three, oblong, smooth, at the base obliquely truncate, surrounded with a whitish pulpy aril of a pleasant acid taste. Bark with a thick soft suber, the outer layer of which exfoliates in patches; inner bark firm and hard, breaking with a short fracture, of a pale red colour. With ferric salts it turns black. Taste very astringent.

Chemical composition.—The bark contains 9·4 per cent. of tannin in its watery extract, and leaves 10 per cent. of ash.

DODONÆA VISCOSA, *Linn.*

Fig.—*Wight Ill. I., t.* 52. Switch Sorrel (*Eng.*).

Hab.—Throughout India. The leaves.

Vernacular—Sanatta, Ban-mendru (*Hind.*), Jakhmi, Bandári (*Mar.*), Bandrike, Bandri (*Can.*).

History, Uses, &c.—This evergeen shrub or small tree is widely diffused, and in Jamaica is known as "Switch-sorrel." According to Dr Bennett it is called "*Apiri*" in Táhiti, and fillets of it were once used for binding round the heads and waists of victors after a battle. The leaves of *D. Thunbergiana* are said to to be used in South Africa against fevers and as a purgative. In India *D. viscosa* does not appear to have been mentioned by Sanskrit writers, but amongst the people it has a certain amount of reputation as a febrifuge. In Réunion the leaves are esteemed as a sudorific in gout and rheumatism, and in Madras they are said to make a capital poultice; from the gum, resin, and albumen present in them one would suppose that they would retain the heat like a linseed meal poultice. From their astringent properties it is probable that they have some febrifuge virtues, while the resins contained in them appear to keep the bowels open. Buchanan in his "Journey through Mysore" mentions Dodonæa, which he calls "Bandury"; he says it indicates a good soil for the cultivation of horse-gram; and he alludes to its use in germinating rice before it is sown, by covering up the moist rice with the leaves, as if the natives were aware of its resinous or waterproof nature. (*Vol. I., pp.* 255—262.)

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Description.—Leaves more or less viscid with a shining yellowish resin, very variable in breadth, 1 to 5 by $\frac{1}{3}$ to $1\frac{1}{2}$ in. They retain their green colour for a considerable time when dried, and when heated in a water-oven fuse together into a mass. Taste sour and astringent.

Chemical composition.—The leaves contain principally two acid resins, one insoluble in ether, and both soluble in alcohol and chloroform. They are dissolved in ammonia and the fixed alkalies with an orange-red colour, and are precipitated on the addition of an acid. The resins amount to 27·3 per cent. of the dried drug. A tannin, giving a greenish colour with ferric salts, forms the bulk of the evaporated spirituous extract soluble in water. The leaves contain 10 per cent. of gum forming a thick ropy liquid in water. No alkaloidal substance was discovered, but a large quantity of albuminous matter was removed by caustic soda. The ash amounted to 5 per cent. of the dried and powdered leaves.

Plants of minor importance belonging to this Order are **Æsculus indica**, the Himalayan Horse Chestnut; the fruit of which is made into a paste and applied externally for rheumatism. The seeds, like those of the European Horse Chestnut, are readily eaten by cattle, and have been made use of as a food by the hill tribes in time of famine. The knots in the stems of **Acer pictum** and **A. cæsium** are made into the curious water-cups supposed by some of the Himalayan hill tribes to have a medicinal influence over the water.

ANACARDIACEÆ.

RHUS CORIARIA, *Linn.*

Fig.—*Dend. Brit.* 136. Elm-leaved Sumach (*Eng.*), Sumac des corroyeurs (*Fr.*).

Hab.—Asia Minor, Persia. The leaves and fruit.

Vernacular.—Sumák or Sumúk (*Arab.*), Tatrak (*Hind.*).

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History, Uses, &c.—The leaves have long been well known in Europe and in the East as a tan and dye, and the fruit as a medicine; the latter is described by Theophrastus and Dioscorides under the name of ῥοῦς as the fruit of a plant used for tanning,* Pliny calls them *Rhus*, and Scribonius Largus mentions them as an ingredient in astringent medicines.† Abu Hanifeh in his "Book of Plants" says that Sumák has bunches of small, intensely red berries, and that it does not grow in any part of the land of the Arabs except Syria. Aitchison informs us that it is cultivated in orchards in Khorasan. The author of the Kámus says "the fruit excites the appetite, stops chronic diarrhœa, and an infusion of it is useful in scurvy (سلاق) and for ophthalmia. It does not appear to be used by the Hindus. The tree is well described in the Makhzan-el-Adwiya by Mir Mohammad Husain, who says that the fruit is cold and dry, astringent, and tonic, that it checks bilious vomiting and diarrhœa, hæmoptysis, hæmatemesis, diuresis and leucorrhœa, strengthens the gums, and is useful as an astringent in conjunctivitis. Alone or mixed with charcoal it is applied to sores, suppurating piles, &c. A kind of liquid extract is made by boiling down the leaves and fruit, which is used as an astringent: poultices of the leaves are recommended as an application to the abdomen in the diarrhœa of children. He also mentions the gum and the russet-coloured down of the fruit as having powerfully astringent properties. Ainslie notices the use of the leaf and fruit in India by the Mahometans as a styptic, astringent and tonic; also their former use in France as an astringent in dysentery, in doses of 24 grains.

Description.—The fruit is a small flattened drupe the size of a lentil, of a red colour, containing one lenticular polished brown seed; it is acid and very astringent. The leaves are about a foot long, pinnate, with from 5 to 7 pairs of leaflets and an odd one, like the leaves of the common elm; the

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* Theophr H. P. iii., 18. Diosc. I., 123.

† Plin. 24. 54, Scrib. Comp. 111 and 142.

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petioles and midribs of the leaflets are covered with a reddish brown tomentum; the leaflets are hairy and very astringent.

Chemical composition.—The leaves contain colouring matter and 14 to 16·5 per cent. of tannin (*Hummel*), and are used in dyeing and calico printing as a substitute for gall nuts, in the production of grey colours, and in Turkey red dyeing; also for tanning the finer kinds of leather. According to Chevreul they contain a yellow colouring matter, which separates from a concentrated decoction on cooling in small crystalline grains. The decoction forms a yellow precipitate with solution of alum, shows a strongly acid reaction with litmus, gives a yellowish white precipitate with stannous chloride, pale yellow with acetate of lead, yellowish brown with cupric acetate, and a blue flocculent precipitate with ferric chloride. Tromsdorf found in the fruit a large quantity of bimalate of lime.

Commerce.—The fruit is imported into Bombay from Persia. Value, 6—8 annas per lb.

The fruit of an Indian Rhus, probably *R. parviflora*, Roxb., or perhaps *R. semi-alata*, Murray, called in Hindi *Tatrak*, is sometimes substituted for it.

PISTACIA INTEGERRIMA, *Stewart.*

Fig.—*Brandis, For. Fl.* 122, *t.* xxii. *Syn.*—Rhus Kákrasingi.

Hab.—Sub-alpine Himalaya. The galls.

Vernacular.—Kákrasingi (*Mar., Guz.*), Kákar-singi (*Hind.*), Kákra-sringi (*Beng.*), Kákkata-shingi (*Tam.*), Kákara-shingi (*Tel.*), Dushtapuchattu (*Can.*).

History, Uses, &c.—These galls, called in Sanskrit Karkata-sringi, have long held a place in the Materia Medica of the Hindus. They are considered tonic, expectorant, and useful in cough, phthisis, asthma, fever, want of appetite, and irritability of stomach. The usual dose is about 20 grains combined with demulcents and aromatics. Mahometan writers describe them as hot and dry, useful in chronic pulmonary affections, especially those of children, also in dyspeptic vomiting and diarrhœa; they notice their use in fever and want of appetite, and say that they are a good external application in cases of psoriasis. European writers mention the drug, but afford no information as to its properties.

Description and Microscopic structure.—The galls are generally single, but sometimes lobed, of a purse-like form, and vary much in size. The average may be, length 1½ inch, breadth 1 inch, thickness ¼ inch. The external surface is of a pale greenish grey, and has a fimbriated appearance. Near the neck or attached end may be seen the midrib of the leaf upon which the gall has been formed; it appears to be split in two; between the halves is a kind of mouth with smooth everted edges (the passage by which the aphides have escaped). On breaking open the gall, which is brittle and about 1-16th of an inch in thickness, the irregular rugose inner surface is seen; it is of a reddish colour, and appears as if covered with particles of dust. This on microscopic examination proves to consist of the *débris* of the former inhabitants of the sac, *viz.*, numerous egg shells beautifully white and transparent, broken portions of the insect, and a quantity of what appears to be excrementitious matter; sometimes the entire aphis may be seen. This insect as obtained from the dry gall is of an oblong form and brown colour, rather more than 1-16th of an inch in length, the whole body is covered with short bristles, four long ones being situated at the end of the abdomen; it has six legs, each armed with two claws; the abdomen is divided into eight segments; the head is armed with a proboscis containing an awl-shaped instrument, and is provided with bristly feelers; the shell of the gall when fractured presents a shining appearance; a thin section shows it to consist of a cellular stroma, the greater number of the cells being entirely filled with a yellowish highly refractive substance. The taste is strongly astringent and slightly bitter.

Chemical composition.—The finely powdered galls of a bright yellow colour were exhausted with boiling water, and the decoction precipitated with acetate of lead. The precipitate washed and suspended in water was decomposed with sulphuretted hydrogen. The solution filtered from the sulphide of lead was evaporated on a water bath to a small bulk and finally dried over sulphuric acid. The tannin thus obtained was of a yellow colour and amorphous, but on boiling in water and examining under the microscope, the yellow powder which separated on cooling was found to be composed of acicular crystals. The aqueous solution gave a white or yellow precipitate with gelatine, yellow with nitrate of lead, and blue-black with ferric acetate; with ammonia and chloride of barium, a yellow precipitate changing to green and brown, and a similar precipitate with lime water. It yielded a white or yellow precipitate with tartar emetic. With molybdate of ammonium a deep red solution was formed. No precipitate was obtained with bromine water.

The tannin digested in alcohol, and the filtered solution allowed to evaporate by exposure to the air, and finally dried over sulphuric acid, was titrated by Löwenthal's permanganate process, using the solution and observing the details recommended by H. R. Procter.* It was found that 1000 c.c. of a $\frac{1}{20}$ normal solution of permanganate of potash was equivalent to 5·560 grammes of the tannin. Two grams of the finely powdered galls were exhausted by boiling with one litre of water for about half an hour and the solution made up to a litre. Twenty cubic centimetres required, as a mean of three titrations, 22 c.c. of permanganate (1 gram in 1000 c.c.). After precipitation of the tannin by the gelatine solution, 50 c.c. = 20 c.c. of the original solution, required 5 c.c. of permanganate; therefore 17 c.c. are equivalent to the tannin in ·04 grams of the galls. By using the above equivalent, (1000 c.c. $\frac{1}{20}$ normal permanganate = 5·56 grams tannin), the galls would contain 75 per cent. of tannin.

The tannin boiled with dilute sulphuric acid, 1 in 12, for about four hours, deposited an abundant reddish-brown powder, the solution acquiring a claret colour. The powder filtered out and well washed with cold water, in which it was but slightly soluble, was shaken three or four times with ether. The ether evaporated left a slight amorphous residue. On further shaking up several times with alcohol, and also with dilute sulphuric acid, a cinnamon-brown powder was obtained, which under the microscope was seen to be composed of minute tabular crystals. This powder was very sparingly soluble in alcohol and dilute acids, more readily dissolved by ammonia and potash solutions, forming a deep claret-coloured liquid and turning the undissolved powder a sulphur yellow colour.

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* *Pharm. Journ.* [3] vii. 1020, and [3]. xvi. 843.

Fused with caustic potash the tannin yields proto-catechuic acid. (*J. G. Prebble.*)

Commerce.—The drug is imported from Northern India, but not in very large quantities. Value, Rs. 2½ to Rs. 3 per maund of 37½ lbs.

PISTACIA TEREBINTHUS, *Linn.*

Fig.—*Blackw.*, *t.* 478; *Bentl. and Trim. t.* 69. Chian Turpentine tree (*Eng.*), Pistachier Terebinthe (*Fr.*).

Hab.—Europe, Asia, Africa. *Syn.*—P. atlantica, *Desf.* P. palæstina, *Boiss.* P. cabulica, *Stocks.* The oleo-resin.

Vernacular.—Khinjak (*Afgh.*, *Pers.*), Gwan (*Biluch.*), The oleo-resin, Cabuli mastaki.

History, Uses, &c.—Flückiger and Hanbury remark:—"The several forms of this tree are regarded mostly as so many distinct species; but after due consideration and the examination of a large number of specimens both dried and living, we have arrived at the conclusion that they may fairly be united under a single specific name." (*Pharmacographia.*) Aitchison after a careful examination comes to the same conclusion.

The terebinth tree was well known to the ancients; it is the τέρμινθος of Theophrastus, τερέβινθος of other authors, and the

Alah of the old Testament. Among its products, the kernels were regarded by Dioscorides as unwholesome, though agreeable in taste. By pressing them, the original *Oil of Turpentine*, τερεβίνθινον ἔλαον, a mixture of essential and fat oil was obtained, as it is in the East to the present day. The resinous juice of the stem and branches, the true, primitive turpentine, ῥητίνη τερμινθίνη, was celebrated as the finest of all analagous products, and preferred both to mastich and the pinic resins. (*Pharmacographia.*) The tree was held in veneration by the Jews; Abraham raised an altar to Jehovah near a grove of Pistacia trees in the valley of Hebron; their dead were buried near the tree. Pliny (13, 12,) notices the fruit of the Terebinthus as well as the galls, "from which issue certain insects like gnats," also a kind of resinous liquid which oozes from the bark. Again (24, 18,) he says:—"The leaves and root of the Terebinthus are used as applications for gatherings, and a decoction of them is strengthening to the stomach. The seed is taken in wine for headache and strangury: it is slightly laxative and acts as an aphrodisiac." Aitchison tells us that *P. Terebinthus* occurs in groups on the low hills of Persia and Afghanistan, the kernels are roasted and eaten, and their oil expressed and used with food. The leaves are used in tanning and dyeing, and on their margins are formed small galls quite distinct from those of *P. vera*. These small galls we have observed in the Bombay market for the first time this year offered for sale as Pistachio galls. The turpentine of *P. Terebinthus* is the Butm of the Arabs, and it seems probable that the particular kind produced in Afghanistan, and known in India as *Mastaki*, is the Ilak-el-Ambat or "turpentine of the Nabathæans" of Isḥák bin Imrán. It is used as a substitute for true mastich or Ilak-er-Rumi, and sometimes appears in the European markets as East Indian or Bombay mastich. In the East it is considered to be detergent, astringent and restorative. A small quantity of true mastich is imported into India from Turkey.

Description.—The general appearance of Cabul mastich is much the same as that of true mastich, but the colour is

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rather deeper, and it wants the fine perfume of the latter article. In the rainy season, unless kept with great care, it runs into a pasty mass. The so-called galls from the margins of the leaves of *P. Terebinthus* are very small sacs, three or four of which communicate together; they are of a pink colour, and have a terebinthinate and astringent taste, and appear to be caused by the presence of an aphis.

Chemical composition.—According to Flückiger and Hanbury, the solution of East Indian mastich in acetone or benzol has the same optical properties as that of true mastich; it deviates the ray of polarised light to the right. (*Pharmacographia.*) East Indian mastich has been examined by Fielding, who found that it differs from the resin of *P. Lentiscus* in being entirely soluble in hot alcohol, becoming only slightly turbid on cooling, whereas 25 per cent. of true mastich remains insoluble in hot alcohol. On the other hand, the latter resin is entirely soluble in turpentine, whereas East Indian Mastich dissolves in hot turpentine but throws down about 25 per cent. on cooling in cauliflower-like crystalline grains. It approaches to the oleo-resin of the European *P. Terebinthus* in these respects, but differs from it in being quite soluble in ether, whereas that oleo-resin gives a cloudy solution with ether, whether hot or cold. True mastich contains a trace of volatile oil and two resins, mastichic acid and masticin. The first is soluble in alcohol without the aid of heat, and has a composition, according to Johnston, of $C^{20} H^{32} O^{2}$. The second resin is insoluble in alcohol but soluble in ether and oil of turpentine; its composition is $C^{20} H^{31} O^{2}$.

Commerce.—The price of Bombay mastich ranges from 8 to 12 annas a pound.

PISTACIA VERA, *Linn.*

Fig.—*Rauw. It.*, 72, *t.* 9; *Guibourt Hist. Nat. iii.*, *p.* 494. The Pistachio nut tree (*Eng.*), Pistachier (*Fr.*).

Hab.—Syria, Persia and Afghanistan. Cultivated in southern Europe. The fruit, galls and husks.

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Vernacular.—Darakht-i-pisteh (*Pers.*) The fruit, Pisteh (*Pers., Ind.*). The galls, Buzghanj (*Pers.*), Gul-i-pisteh (*Pers., Ind.*), Getela (*Beng.*).

History, Uses, &c.—The tree forms forests at an altitude of 3,000 feet in the Badghis and Khorasan; it is also cultivated in Persia. The forests are known as Pistalik, and are a source of considerable profit to their owners. (*Aitchison.*) The wild fruit is smaller and more terebinthinate in flavour than the cultivated. Many people prefer it. Pistachio nuts were known to the ancients, who introduced the tree into Europe According to Pliny, they were first brought to Rome by Lucius Vitellius, Governor of Syria, about the end of the reign of Tiberius. From Rome they were carried into Spain, and are now cultivated throughout Southern Europe. The Arabs call Pistachio nuts Fustuk, and consider them to be digestive, tonic and aphrodisiac; they prepare a loch (لوخ) with them, which is known in French Pharmacy as *Looch vert ou des pistaches.* The outer husk of the fruit is used in dyeing and tanning, and is imported into Bombay from Persia under the name of *Post-i-pisteh.* The galls which are produced on the leaves of the tree are terebinthinate and astringent, and are used in dyeing and tanning, and also as an astringent medicine; they are called Buzghanj in Persia, but are best known as Gul-i-pisteh in India. The word Buzghanj appears to be derived from *Biz,* an old Persian name for a bee or fly or other buzzing insect, and *Ghanj*, a bag or sack. The Mahometans use Pistachio nuts in cookery and medicine.

In India they are roasted in their shells in hot sand, and thrown into a hot paste of salt and water, and stirred so as to cause the salt to adhere to the shell, much as sugar does to a burnt almond. They are hawked about the streets in large towns under the name of *Khára Pisteh* (salted Pistachio nuts). The almonds are much used by sweetmeat makers.

Description.—The galls when fresh are bright pink on one side and yellowish white on the other; they vary much in shape and size, some being perfectly fig-shaped and others almost spherical, the majority are ovoid; at one end a portion of leaf

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often remains attached; here may be seen an open stoma which communicates with the interior of the sac; the apices are pointed, often mucronate. The largest galls are an inch in length; some are no larger than a pea. The walls are thin, brittle, and translucent; the taste acidulous, very astringent and slightly terebinthinous; the odour terebinthinous. Most of the sacs contain only a little fecal *debris*, but in some an aphis may be found. According to Lichtenstein this aphis (*Anopleura Lentisci*) runs through the following stages:—The fecundated female deposits in May or June its eggs on the pistachio tree; these hatch into a wingless form, to which the pistachio gall owes its origin; the wingless form produces, without being fecundated, another brood, which acquire wings and quit the gall and pass to the roots of certain grasses (*Bromus sterilis* and *Horduem vulgare*), and then produce wingless young, and these, after a longer or shorter series of wingless generations, until the period of swarming and of the appearance of the nymphs, furnish a winged sexual generation, which return to the pistachio tree and again commence the cycle.

The fruit of the Pistachio is about the size of an olive, and consists of a moist reddish husk having an astringent taste and terebinthinate odour, which encloses a white woody shell separating into two valves and containing an angular almond having hin purplish red skin, within which are two green oily coty- ons having an agreeable somewhat terebinthinate flavour. bbed with water the seed forms an emulsion.

Chemical composition.—65 per cent. of the galls is soluble in ter, 75 per cent. in spirit and 31 per cent. in ether. They ntain 45 per cent. of tannin allied to gallo-tannic acid, besides llic acid, and 7 per cent. of a resin or oleo-resin to which odour is due.

MANGIFERA INDICA, *Linn.*

Fig.—*Beddome Fl. Sylv., t.* 162; *Gart. Fruct., t.* 100. tree (*Eng.*), Manguier (*Fr.*).

.b.—East Indies. Cultivated elsewhere. The fruit, , leaves, flowers, bark and gum.

Vernacular.—Amb, Am (*Hind.*), Amba (*Mar.*), Manga-maram (*Tam.*), Ambaj (*Arab.*), Naghzak (*Pers.*), Ambo (*Guz.*), Ma (*Mal.*).

History, Uses, &c.—The Mango, in Sanskrit Ámra, Chúta and Sahakara, is said to be a transformation of Prajápati (lord of creatures), an epithet in the Veda originally applied to Savitri, Soma, Tvashtri, Hiranga-garbha, Indra, and Agni, but afterwards the name of a separate god presiding over procreation. (*Manu* xii., 121.) In more recent hymns and Bráhmanas Prajápati is identified with the universe.

The tree provides one of the *pancha-pallava* or aggregate of five sprigs used in Hindu ceremonial, and its flowers are used in Shiva worship on the Shivarâtri. It is also a favourite of the Indian poets. The flower is invoked in the sixth act of Sakuntala as one of the five arrows of Kámadeva. In the travels of the Buddhist pilgrims, Fah-hian and Sung-yun (translated by Beal) a Mango grove (Ámravana) is mentioned which was presented by Ámradárika to Buddha in order that he might use it as a place of repose. This Ámradárika, a kind of Buddhic Magdalen, was the daughter of the mango tree. In the Indian story of Súrya Bai (*see Cox, Myth. of the Arian Nations*) the daughter of the sun is represented as persecuted by a sorceress, to escape from whom, she became a golden Lotus. The king fell in lo with the flower, which was then burnt by the sorceress. Fr its ashes grew a mango tree, and the king fell in love fi with its flower, and then with its fruit; when ripe the f fell to the ground, and from it emerged the daughter of the (Súrya Bai), and was recognized by the prince as his lost w Long articles upon the virtues of the mango in its ripe unripe state (kéri) may be found in Hindu and Mahome works on Materia Medica.

The Turkoman poet, Amír Khusru, who lived in Delhi in time of Muhammad Tughlak Shah, says of it:—

ک خوش نغزکن بوستان   نغزترین میوهٔ هندوستان
وه بباغ ارنر یکی ده بود   پختہ شود خوردنش انگہ شود
بوهٔ نغزک هم از آغاز بر   تا حد انجام سزاوار خور

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"The mango is the pride of the garden, the choicest fruit of Hindustan; other fruits we are content to eat when ripe, but the mango is good in all stages of its growth."

Shortly, we may say that they consider the ripe fruit to be invigorating and refreshing, fattening, and slightly laxative and diuretic; but the rind and fibre, as well as the unripe fruit, to be astringent and acid. The latter when pickled is much used on account of its stomachic and appetising qualities. Unripe mangos peeled and cut from the stone and dried in the sun form the well-known Ámchúr or Ambosí (Ámrapesi, *Sans.*,) so largely used in India as an article of diet; as its acidity is chiefly due to the presence of citric acid, it is a valuable antiscorbutic; it is also called Ám-ki-chhiṭṭa and Ám-khushk. The blossom, kernel and bark are considered to be cold, dry and astringent, and are used in diarrhœa, &c., &c. The smoke of the burning leaves is supposed to have a curative effect in some affections of the throat. According to the author of the Makhzan, the Hindus make a confection of the baked pulp of the unripe fruit mixed with sugar, which in time of plague or cholera they take internally and rub all over the body; it is also stated in the same work that the midribs of the leaves calcined are used to remove warts on the eyelids. Mangos appear to have been known to the Arabs from an early date as a pickle; they were doubtless carried to Arabian ports by Indian mariners. Ibn Batuta, who visited India A.D. 1332, notices their use for this purpose. The powdered seed has been recommended by Dr Kirkpatrick as an anthelmintic (for lumbrici) in doses of 20 to 30 grains, and also as an astringent in bleeding piles and menorrhagia. (*Phar. of India*, *p.* 59.) From the fruit just before ripening, a gummy and resinous substance exudes, which has the odour and consistence of turpentine, and from the bark a gum is obtained which is partly soluble in cold water. Ainslie says that the gum-resin mixed with lime-juice or oil is used in scabies and cutaneous affections. The juice of the ripe fruit dried in the sun so as to form thin cakes (Amras, or Amaut, *Hind.*, Ambapoli, *Mar.*, Amravarta, *Sans.*,) is used as a relish and antiscorbutic. Mango bark and fruit have been lately introduced by

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Dr. Linguist to the notice of European physicians (*Practitioner*, 1882, 220); he recommends it for its extraordinary action in cases of hæmorrhage from the uterus, lungs, or intestines. The fluid extract of the bark or rind may be given in the following manner:—Ext. Fl. Mangif. Ind., 10 grams; water, 120 grams. Dose—One teaspoonful every hour or two, or the juice of the fresh bark may be administered with white of egg or mucilage and a little opium.

The wood is used largely for packing cases and tea chests, but it should be previously seasoned, otherwise the acid juice it naturally contains corrodes the lead.

Description—The Mango is a large fleshy drupe, ovoid or kidney-shaped; it varies much in size, ordinarily it is about as large as a goose's egg, but in the Southern Concan and Goa there is a variety called Bispo or the Bishop, which attains the size of a child's head. The pulp has a terebinthinate sweet and acidulous taste. The nut varies in size, is somewhat reniform and laterally compressed; it consists of a woody endocarp covered with woody fibres. The seed has two distinct membranous envelopes, the outer one is of the nature of an aril and white, the inner or proper integument consists of two coats closely united, the outer white, the inner of a dark red colour. The two cotyledons are spirally twisted, and lobed, their taste bitter and astringent. The gum occurs in irregular-shaped pieces, some of them stalactiform and shining; it is variable in colour and solubility, brittle, the fractured surface dull, the odour faint and gummy. At the time of flowering a gum-resinous exudation occurs upon the tender portions of the plant.

Chemical composition.—Professor Lyon (1882) examined the dried unripe peeled fruit, and found it to contain water 20·98, watery extract 61·40, cellulose 4·77, insoluble ash 1·43, soluble ash 1·91., alkalinity of soluble ash as potash ·41, tartaric acid, with a trace of citric acid 7·04, remaining free acid as malic acid 12·66, total free acid per 100 parts air dry substance 24·93.

The orange colouring matter of the ripe mango is a chlorophyll product, readily soluble in ether, bisulphide of carbon and benzol, but less readily soluble in alcohol. It yields with these solvents deep orange-coloured solutions which are bleached by solution of chlorinated soda, and turned green by hydrochloric or sulphuric acids, the orange colour being again restored by an alkali.

The bark and seeds contain a tannin. Fifty grams of the powdered seed exhausted with alcohol, 90 per cent., filtered, the alcohol evaporated off on the water bath, and the residue dried over sulphuric acid, left an extract weighing 3·16 grams. Of this extract ·3 gram was of a resinous nature, and insoluble in water. The portion soluble in water, equivalent to 5·72 per cent. of the seed, gave the usual reactions of a tannin. The aqueous solution of the tannin was precipitated with gelatine, filtered, and the filtrate shaken two or three times with ether. No appreciable residue was obtained by the evaporation of this ethereal extract showing the absence of gallic acid. (*J. G. Prebble.*)

ANACARDIUM OCCIDENTALE, *Linn.*

Fig.—*Beddome Fl. Syl., t.* 163 ; *Rheede, Hort. Mal. iii., t.* 54. Cashew-nut tree (*Eng.*), Anacardier (*Fr.*).

Hab.—America. Cultivated in India. The tar, spirit and almonds.

Vernacular.—Kájú (*Hind., Guz., Mar.*), Kottai-mundiri (*Tam.*), Hijli-bádám (*Beng.*), Jidi-mámidi-vittu (*Tel.*), Gera-poppu (*Can.*).

History, Uses, &c.—A native of Brazil, which has been introduced into India by the Portuguese. Rumphius tells us that the fruit is called in Amboyna *Boa Frangi*, or Portuguese fruit ; it was not known in Goa A.D. 1550 ; but Christopher a Costa saw it in Cochin shortly after this. The later Mahometan writers notice it as a variety of Biládur (*Semecarpus Anacardium*), and call it Bádám-i-Farangi. In 1653 only a few trees existed on the Malabar Coast ; since then it has become completely naturalized on the Western Coast, but is nowhere so abundant as in the Goa territory, where it yields a very considerable revenue. It is planted upon the low hilly ridges which intersect the country in every direction, and which are too dry and stony for other crops. The cultivation gives no trouble, the jungle being simply cut down to make room for the plants. When three years old the trees begin to bear. The principal products are, a spirit distilled from the fermented juice of the torus, the kernels of the nuts, and a tar obtained by roasting the pericarp of the fruit. The apparatus used for extracting the juice from the torus consists of a large circular stone basin with a spout, into which a heavy circular stone is fitted. The torus, having been sliced and well trodden by the feet, is placed in the basin and the stone weight placed upon it; after all the juice has been expressed, it is allowed to ferment in earthen jars, and then distilled. The product is a weak spirit, which is sold for about 4 annas a gallon, and is also re-distilled to about the strength of proof-spirit, when it is worth about Re. 1½ per gallon. The fruit is roasted in an earthen perforated vessel until the whole of the tar (Deek) has been extracted from the pericarp. The kernel which has become roasted slightly during this process is then removed and preserved for sale. The tar is largely used for tarring boats and wood-work, which it preserves from the attacks of insects. The nuts are exported, and are used in making native sweetmeats, and as a table fruit by Europeans. From the juice of the torus a kind of wine is made by the Portuguese: both it and the spirit are considered to have diuretic and sudorific properties, and are valued as external applications in rheumatism. The leaves and flowers of the cashewnut are aromatic; from the stem exudes a large quantity of gum in stalactitic masses sometimes as thick as a man's wrist; it is made no use of in Goa, but is said to be used in America by book-binders to keep their books from the attacks of insects. The bark though not used in India is said to have alterative properties; it is rich in tannic acid, and a decoction makes a good astringent wash. The tar already mentioned, which contains about 90 per cent. of anacardic acid and 10 per cent. of cardol, has recently been recommended as an external application in leprosy, ringworm, corn and obstinate ulcers; it is powerfully rubefacient and vesicant, and requires to be used with caution. In native practice it is sometimes used as a counter-irritant. MM. Corre and Lejanne (*Résumé de la Mat. Med. et. Tox. Coloniale*) state that a good epispastic ointment may be made by incorporating one part of it with eight parts of lard or vaseline, and a blistering paste by mixing it with wax in equal proportions. Dr. Brassac considers it to be a good, rapid, and safe vesicant, producing a copious flow of serum and notable reduction of hypertrophy in tuberculous leprosy; he advocates its general use as a vesicant. (*Rapport sur la méthode Beauperthuy, Basse Terre*, 1872.) In Europe a tincture of the pericarp (1 to 10 of rectified spirit) has been used in doses of 2 to 10 minims as a vermifuge. It is stated (Buchheim) that the oil has a very faint and hardly-acrid taste, and that 3 or 4 drops of it may be swallowed without marked effects. This contrast with its action on the skin is attributed to its total insolubility in the watery fluids of the digestive canal. According to Basiner, the sub-cutaneous injection of small doses of cardol produces on cold-blooded animals paresis, increasing to paralysis of the extremities, stupor, paralysis of respiration and tetanic spasms. In warm-blooded animals large doses are not lethal, but stupor, paralysis of the extremities and diarrhœa occur, and after death congestion of the intestinal lining is found. Cardol seems to be excreted chiefly with the urine, but partially also with the fæces. Applied on a small piece of lint to the skin of the breast it raised a watery blister in 14 hours. (*Am. Journ. Pharm., Mar.* 1882, p. 131) The kernel contains a bland fixed oil; it may be eaten raw or roasted.

Description.—The fruit, which is about an inch in length and kidney-shaped, is seated upon a large pyriform fleshy body 2 to 3 inches long, and coloured like an apple red and yellow, formed of the enlarged disk and top of the peduncle. The pericarp is cellular and full of oil; seed kidney-shaped; testa membranaceous, adherent; cotyledons semilunar; radicle short, hooked. The spirit has a peculiar

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and rather disagreeable flavour, which appears to be derived from a volatile aromatic principle present in the rind of the torus and similar to the ferment oil of apples; this can be removed by proper rectification. The gum occurs in stalactiform masses, and varies in colour from reddish to pale yellow; when placed in water it swells and forms a jelly-like mass and a portion of it dissolves; this solution is rendered turbid by oxalate of ammonium, and gives a copious white precipitate with alcohol; it is not precipitated by borax or sulphate of iron.

Chemical composition.—Anacardic acid together with cardol is contained in the pericarps of the cashew nut. To obtain it they are extracted with ether, which dissolves out both the anacardic acid and the cardol; the ether is distilled off, and the residue after washing with water to free it from tannin, is dissolved in 15 to 20 times its weight of alcohol. This alcoholic solution is digested with recently precipitated oxide of lead, which removes the anacardic acid in the form of an insoluble lead salt. After repeated purification the acid is obtained as a white crystalline mass which melts at 26° C. It has no smell, but its flavour is aromatic and burning. When heated to 200° C. it is decomposed, producing a colourless very fluid oil. It burns with a smoky flame, emitting an odour like that of rancid fat. Alcohol and ether dissolve it readily, and these solutions redden litmus. Some of its salts are crystalline. Formula $C^{44} H^{64} O^{7}$, or $C^{44} H^{32} O^{7}$. MM. Ruhemann and Steinner, who have recently (1887) examined anacardic acid, give it the formula $C^{44} H^{36} O^{6}$, and consider it to be hydroxy-carboxylic acid. By acting upon iodide of methyl with its silver salt, they obtained a methyl compound which was decomposed by distillation with a disengagement of carbonic acid. (*Jour. of the Chem. Soc.*, 1887, p. 663.) After the removal of the anacardic acid, the alcoholic solution which contains the cardol is distilled to recover the spirit, and water added to the remaining liquid till it becomes turbid, and afterwards acetate and subacetate of lead till it is decolorised; lastly, the lead is precipitated by sulphuric acid. Cardol is a yellow oily liquid, insoluble in water, very

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soluble in alcohol and ether; the solutions are neutral to litmus. This substance is not volatile, but decomposes when heated. It blisters the skin strongly. According to Stadeler, it contains 60 per cent. of carbon and 8·8 or 8·9 of hydrogen, whence he deduces the formula $C^{42} H^{51} O^{4}$; it should perhaps be $C^{21} H^{30} O^{2}$. (*Cf. Stadeler, Ann., Ch. Pharm.*, lxiii., 137.)

The oil of the almonds is sweet, pale-yellow, sp. gr. 0·916; that of the mesocarp is thick, brown and viscid, sp. gr. 1·014; it reddens litmus, and turns darker when exposed to the air; it is soluble in alcohol and ether, and dyes linen of a permanent yellow-red. (*Lepine.*)

This oil was found by A. Basiner (1881) to be soluble in potassa, with a red colour, darkening on exposure, and its alcoholic solution to yield a red precipitate with basic lead acetate. Cazeneuve and Latour have found catechin in the wood of the Cashew tree. The fruit yields 1·64 per cent. of ash. (*Wernecke.*)

Commerce.—Cashew nuts (Fèves de Malac, *Fr.*) are imported into Bombay from Goa in very considerable quantities. Value—The Kernels, Rs. 18 per cwt.; the Tar, Re. ½ per gallon in Goa.

SEMECARPUS ANACARDIUM, *Linn.*

Fig.—*Roxb. Cor. Pl. I., t.* 12; *Wight Ic., t.* 558; *Beddome Fl. Sylv., t.* 166. Marking-nut tree (*Eng.*), Sémécarpe á larges feuilles (*Fr.*).

Hab.—Hotter parts of India. The fruit.

Vernacular.—Bhéla, Bhilawa (*Hind.*), Bibba (*Mar.*), Shénkottai, Sheran-kottai (*Tam.*), Bhilamo (*Guz.*), Geru (*Can.*), Sambiri, Thembari (*Mal.*).

History, Uses, &c.—The marking-nut, in Sanskrit Bhallátaka and Arushkara (causing sores), is regarded by the Hindus as acrid, heating, stimulant, digestive, nervine and escharotic, and is used in dyspepsia, piles, skin diseases, and nervous debility. It is prepared for internal use by being boiled with cowdung and afterwards washed with cold water.

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The nut is also used to produce the appearance of a bruise in support of criminal charges preferred through enmity,* and the juice is sometimes applied to the body out of revenge, the victim having first been made insensible by the administration of narcotics. In Sanskrit medicinal works a section is often devoted to the treatment of ulcerations thus produced. When given internally the juice of the pericarp is always mixed with oil or melted butter. It is the Anacardia of Serapion. The Arabic name for the nut is Baládar, or Hab-el-kalb, in allusion to its heart-shaped form.

Ibn Baitar says—

البلادر بالهندية هو انقرديا بالرومية و معناه الشبيه بالقلب

(Baládar in the Indian language is Ancardia in Greek, which means "heart-shaped.") Mahometan writers order the juice to be always mixed with oil, butter, or some oily seed when used for internal adminstration. They consider it to be hot and dry, useful in all kinds of skin diseases, palsy, epilepsy, and other affections of the nervous system, the dose being from ¼ to ½ a dirhem. Externally they apply it to cold swellings, such as piles; the Tuhfat notices the use of the vapour of the burning pericarp for this purpose, a practice known in Bombay; it causes sloughing of the tumours. When too large a quantity has been taken, oily and mucilaginous remedies should be prescribed. Two dirhems is considered a poisonous dose. Some persons are much more readily affected by the drug than others. Garcia d'Orta remarks that the poisonous properties of the marking-nut have been much exaggerated by Serapion, and goes on to say that in Goa it is administered internally in asthma after having been steeped in buttermilk, and is also given as a vermifuge: and moreover says he, we (the Portuguese) salt the young green fruit and use them like olives. Ainslie gives the following account of its use in Southern India: "The Hindus give the juice in scrofulous, venereal and leprous affections in very small doses; an oil is also prepared with the nut by boiling, which is used externally in rheumatism and sprains, it is of a very stimulating nature; undiluted it acts as a blister. The Telingoos have the following prescription :—Juice of marking-nut and garlic of each 1 ounce, juice of fresh tamarind leaves, cocoanut oil and sugar of each 2 ounces; mix, and boil for a few minutes. Dose—One table spoonful twice daily in syphilis, aches, sprains," &c. Mixed with a little quicklime and water the juice is used all over India for marking linen, and the stain is far more durable than that of the marking inks of Europe.

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* Its application in a diluted form produces great œdematous swelling and redness of the skin.

In the Concan a single fruit is heated in the flame of a lamp and the oil allowed to drop into a quarter ser of milk; this draught is given daily in cough caused by relaxation of the uvula and palate. As an application to scrofulous glands of the neck equal parts of the juice of the marking nut, *Plumbago zeylanica, Baliospermum montanum, Euphorbia neriifolia, Asclepias gigantea*, sulphate of iron, and molasses are used. The juice of the root-bark is also used medicinally on account of its acrid properties.

The brown oil of the marking-nut appears to resemble very closely in its medicinal action that of the cashew-nut (see above). Basiner found that within 12 hours it raised a black blister; this should be carefully protected from touch, as the fluid causes eczematous vesicles on any part of the body it may come in contact with. Basiner has also noticed painful micturition, the urine being reddish brown and bloody, and painful stools as a sequel to the external application of the oil. (*Am. Journ. Pharm. Mar.* 1882, p. 131.) In a case of accidental blistering by the juice, recently under clinical observation in Calcutta, and reported by Dr. C. L. Bose, the most marked feature was its prolonged irritant action on the skin, although washed off with cold water within a quarter of an hour of the accident. Blisters began to appear about two hours after the application of the juice, and continued to form for three days, apparently caused by the fluid from the broken vesicles. No irritation of the bladder or intestines was observed, but there was intolerable itching and burning of the skin attended by a febrile condition. Most relief was obtained by the application of hot oil. Like the oil of the cashew-nut, this oil appears to have a much less injurious effect than would be expected, when administered internally.

Toxicology.—The marking-nut is seldom if ever given as a poison internally, but is used as a local irritant to procure abortion, often causing much injury to the uterus and vagina; a case of this kind is recorded by Chevers and another by Burton Brown. In Bombay a case has been reported in which the juice was used to cause hurt to a wife by disfiguring her face, and Dr. Gray has observed a case in which the nut was introduced into the vagina as a punishment. Marking-nuts have also been used by malingerers to produce ophthalmia and skin eruptions.

Description.—The marking-nut is well described by the Arabs as resembling the heart of an animal, the torus representing the auricles, and the fruit the ventricles; in the dry commercial article the torus is seldom present, and the fruit is of the size and shape of a broad bean, of a black colour, and quite hard and dry externally, but upon breaking the outer skin with a knife, the central cellular portion of the pericarp will be found full of a brown oily acrid juice; inside the pericarp is a thin shell conforming to it, and containing a large flat kernel, which has no acrid properties. The root-bark is very thick, and contains a large quantity of acrid juice similar to that found in the pericarp; it dries into a black varnish.

Chemical composition.—The almonds contain a small quantity of sweet oil; the pericarp contains 32 per cent. of a vesicating oil of specific gravity ·991, easily soluble in ether, and blackening on exposure to the air. It is similar to that of *Anacardium occidentale*, but Basiner (1881) found that it dissolves in potassa with a green colour, and its alcoholic solution turns black with basic lead acetate. The fruit yields 2·14 per cent. of ash. (*Warnecke.*)

Commerce.—Marking-nuts come from various parts of the country. Value, ¾ to 1 Rupee per Surat maund of 37½ lbs.

ODINA WODIER, *Roxb.*

Fig.—*Wight Ic., t.* 60; *Beddome Fl. Sylv., t.* 123; *Royle Ill., t.* 31.

Hab.—Hotter parts of India. The bark and gum.

Vernacular.—Jingan Mohin, Kimul (*Hind.*), Shimti (*Can.*), Odiya-maram (*Tam.*), Jival (*Beng.*), Uthi (*Mal.*), Oddi-mánu (*Tel.*), Moye (*Mar.*), Shembat (*Guz.*).

History, Uses, &c.—This tree is called in Sanskrit Jingini, Ajashringi (goat's horn), and Netraushadhi (collyrium). The juice is considered by the Hindus to be a valuable application to sore eyes. Ainslie mentions that the bark powdered and mixed with Margosa oil is considered by the Vytians as a valuable application to old and obstinate ulcers; according to Wight, the gum beaten up with cocoanut milk is applied to sprains and bruises, and the leaves boiled in oil are used for a similar purpose. In the Pharmacopœia of India the astringent properties of the bark are noticed, and its use as a lotion in impetiginous eruptions and obstinate ulcerations. A decoction of the bark is recommended by Dr. B. Bose as an astringent gargle. At Pondicherry the bark is administered in gout and dysentery; it has a stimulant action. (*Corre et Lejanne.*)

Description.—The gum is partly in tears of a yellowish tinge, and partly in colourless angular fragments, which are full of fissures like gum Arabic. It has a disagreeable taste and is not astringent, about one-half of it is completely soluble in water, the remaining portion forms a slimy mucilage, but is not gelatinous; the soluble portion, which is feebly acid, is precipitated by alcohol, and in a less degree by oxalate of ammonium, not at all by perchloride of iron or borax. The bark is very astringent, thick and soft, of a light brown colour externally, marked with numerous whitish scars, where portions of the dry suber have fallen off, also with many small scabrous rusty spots; internally it is white when fresh, but dries of a reddish brown, a gummy juice exudes from it when cut; there are large laticiferous vessels which contain the gummy juice.

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Chemical composition.—The powdered bark exhausted with hot water affords 15 per cent. of extract containing 9·1 per cent. of tannin. The ash (9·3 per cent.) is very deliquescent on account of the presence of a considerable quantity of potassium carbonate.

BUCHANANIA LATIFOLIA, *Roxb.*

Fig.—*Bedd. Fl. Sylv.* t. 165.

Hab—Hot, drier parts of India, ascending to 3,000 feet. The seeds.

Vernacular.—Chironji, Piyár, Piyál (*Hind.*), Chirongi, Piyál (*Beng.*), Chároli (*Guz.*), Chára, Chároli (*Mar.*), Moreda, Mouda (*Tam.*), Chára-pappo, Morala (*Tel.*), Nuskul, Murkalu (*Can.*), Chirauli (*Punj.*), Mura, Munga Peru (*Mal.*).

History, Uses, &c.—This tree is called in Sanskrit Piyála, Chára and Tápasa-priya, or "dear to hermits." The seeds are an article of commerce, and appear to have been in use from a remote period in the preparation of sweetmeats, and as an ingredient in demulcent cough mixtures, generally in combination with dates, almonds, sesamum and cucumber seeds. Similar mixtures are also prescribed as a nourishment in debility. Charred slightly over the fire they form an excellent after-dinner dish. The oil has been recommended for baldness. The bark is used in Tranvancore for tanning.

Description—The fruit is a sub-globose, slightly compressed drupe, half inch in diameter, of a deep purple colour. Stone hard, 2-valved. Kernels laterally compressed like a vetch seed, brown, mottled with darker brown, rather more than ¼ inch in length, and rather less than ¼ inch in breadth. Slight pressure separates the oily cotyledons, which have a very agreeable nutty flavour.

Chemical composition.—The seeds have been examined by Church, who found in 100 parts—Water 5 7, albuminoids 27·9, mucilage, &c., 2·7, oil 58·6, fibre 1·8, ash 3·3. The expressed oil of the seeds commences to congeal into a white semi-solid mass at 18·5° C., at which temperature it has a specific gravity of 0·9134. It affords 95·7 per cent. of insoluble fatty acids melting at 36°. The lead soap of the fatty acids was soluble to the extent of 38 per cent. in ether, as lead oleate; the fatty acids from the insoluble portion melted at 57°, and possessed the characters of a mixture of palmitic and stearic acids.

Commerce.—Chirongi seeds are obtainable at about 4 annas per pound.

SPONDIAS MANGIFERA, *Willd.*

Fig.—*Wight Ill. I.* 186, *t.* 76; *Bedd. Fl. Sylv.*, *t.* 169. Hog plum tree, Wild mango (*Eng.*), Mombin de Malabar (*Fr.*).

Hab.—Throughout India. The fruit and gum.

Vernacular.—Ambra, Amra (*Hind.*, *Beng.*), Ambáda (*Mar.*), Mari-manchedi (*Tam.*), Toura-mamidi (*Tel.*), Pundi (*Can.*)

History, Uses, &c.—This tree is the Amrátaka, Amrát, and Adhvaga-bhogya (traveller's delight) of Sanskrit writers, who describe the pulp of the fruit as acid and astringent and useful in bilious dyspepsia, on which account the name of Pittavriksha, or "bile tree," is applied to it. It is the Condondum Malaccense of Rumphius (I., 51). The fruit is much used by the Hindus as an acid vegetable, and they make a preparation of it resembling gooseberry fool, which is called Ráyeté.* The leaves and bark are astringent and aromatic, and are administered in dysentery, and the gum is used as a demulcent.

Description.—The drupe is oval, fleshy, smooth, the size of a pullet's egg, and yellow when ripe; nut oblong, woody, very hard, outwardly fibrous, 5-celled, from 1 to 3 cells only are fertile; seed lanceolate; embryo inverse, without perisperm. The gum is yellowish or light brown, principally in

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* रायतें (*Mar.*), राएता (*Hind.*) is a semi-fluid dish prepared with a little mustard, milk, and the pulp of some acid fruit.

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stalactiform pieces. It resembles tragacanth in its behaviour with water, 40 grains form with 2 ounces of water a transparent jelly of a light brown colour, in a dilute solution the insoluble portion deposits, and the small portion which is soluble gives with neutral acetate of lead a white precipitate, with basic acetate an opaque white precipitate, with ferric chloride a reddish gelatinous precipitate, with Fehling's solution there is a slight reduction on boiling, with ammonium oxalate a copious precipitate, it is precipitated by alcohol, but is unaffected by iodine, nitrate of silver and borax.

A remarkable gum-like secretion is yielded by a species of Spondias introduced in Bangalore. It dissolves without swelling in water, and forms a milky and soapy solution. One-sixth of this substance is soluble in rectified spirit, and although insoluble in water is unctious and soapy to the touch.

MORINGEÆ.

MORINGA PTERYGOSPERMA, *Gärtn.*

Fig.—*Wight Ill. I.* 186, *t.* 77; *Bedd. Fl. Syl., t.* 80. The Horse-radish tree (*Eng.*), Moringa à graines triptères (*Fr.*),

Hab.—India. The fruit, bark, gum, seeds and root.

Vernacular.—Sahjna (*Hind.*), Shegva, Shegat (*Mar.*), Murungai (*Tam.*), Saragavo (*Guz.*), Nugge (*Can.*), Munaga (*Tel.*).

History, Uses, &c.—The root of this very common tree, the Sobhanjana, Murungi and Danshamula (pungent root) of Sanskrit writers, is described by the Hindus as acrid, pungent, stimulant and diuretic, and is applied externally as a rubefacient. The seeds are said to be stimulant and are called Sveta maricha (white pepper). The Bhavaprakása mentions two varieties of the tree, *viz.*, white and red.* The white is said to be the stronger rubefacient, but the red is preferred for internal use; it is given in ascites arising from enlargement of the liver and spleen. In internal and deep-seated inflammation and abscess (vidradhi), a decoction of the root bark is recommended to be given with the addition of asafœtida and rock salt. The root bark is besides used externally as a plaster, and the inflamed part fomented with its decoction. A decoction of the root bark is considered useful in calculous affections. The seeds are an ingredient in some stimulant applications. The gum of the tree, mixed with sesamum oil, is recommended to be poured into the ears for the relief of otalgia; it is also rubbed with milk and applied in headache to the temples. Mahometan writers describe Sahjna flowers as hot and dry, and consider that they expel cold humours, disperse swellings, act as a tonic and diuretic, and increase the flow of bile. The juice of the root with milk is diuretic, antilithic and digestive, and is useful in asthma. A poultice made with the root reduces swellings, but is very irritating and painful to the skin. The pods are a wholesome vegetable, and act as a preventive against intestinal worms (*vide* Makhzan, article Sahjna). Ainslie mentions the use of the Morunghy root by Europeans as a substitute for Horseradish. He also says that the native doctors prescribe it as a stimulant in paralytic affections and intermittent fever in doses of about one scruple; that they also employ it in epilepsy and hysteria, and consider it a valuable rubefacient in palsy and chronic rheumatism. He wrongly supposes the seeds to be the Hab-el-bán of the Arabians. Rumphius and Loureiro state that the bark is emmenagogue and even abortifacient. In Bengal half-ounce doses of the bark are said to be used to procure abortion. In Madras the following prescription is said to be a good remedy for scorpion stings:—Moringa bark and nut of each 4 ozs., tobacco 2 ozs., gunpowder 2 drachms. Make into a smooth paste, roll into a pencil and dry. When required rub it with a little water over the sting. According to Fleming, the oil of the seeds is used as an external application for rheumatism in Bengal. In India the root is generally accepted by Europeans as a perfect substitute for Horseradish. The unripe pods are used as a vegetable; they may

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* Probably *M. concanensis*, Nimmo, which has red flowers.

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be boiled and served with melted butter, or cut in pieces and mixed with curries. The flowers are eaten in curries, and also fried with butter. The young leaves are boiled with onions and spices and used in the same manner. A decoction of the root bark is used as a fomentation to relieve spasm. In the Concan the bark of the wild tree is ground with Plumbago root, pigeon's dung, and chicken's dung and applied to destroy Guinea-worms. Four tolás of the juice of the leaves of the cultivated tree are given as an emetic. The gum is said to be used to produce abortion, but it is difficult to obtain any reliable evidence upon a point of this nature; it would be quite possible to use it as a tent to dilate the os uteri, as it is very tough, and swells rapidly when moistened. In many parts of India the right of collecting the pods upon Government lands, for sale as a vegetable, is leased; they are never allowed to ripen, and the oil is not expressed. The Bengal Pharmacopœia furnishes formulæ for a compound spirit and compound infusion. In the Pharmacopœia of India the plant is placed in the secondary list, and its principal uses are briefly noticed.

Description.—The fruit is light brown when ripe, a foot or more in length, triangular, ribbed, and composed of three valves containing a soft white pith, and a single row of from 12—18 seeds, which are dark brown, roundish, the size of a pea, and furnished with three membranaceous wings. The kernel is white, oily and bitter. The gum, when it first exudes, is opaque and white; from exposure to the air it soon becomes pink, and finally of a dull red colour on the surface, the interior remaining white. It occurs in pieces of considerable size, generally more or less vermicular in form, and appears to be only produced upon trees which have been injured by insects. The taste is bland and mucilaginous. In dry air the gum becomes very friable, but in a damp climate it is tough and holds 20 per cent. of its weight of water. The bark of the root has a reticulated light brown external surface; it is thick, soft, and internally white, and has a pungent odour and taste, exactly like Horseradish. The wood of the root is soft, porous, and yellowish, and has the same properties in a less degree.

Microscopic structure.—The parenchyme cells of the bark are loaded with globules of essential oil. The wood is provided with very large scalariform vessels easily visible with the naked eye. The medullary rays both in the wood and bark are very distinct.

Chemical composition.—The root distilled with water yields an essential oil which appears to have much pungency, but the odour is distinct from that of oil of mustard and garlic, and more offensive. The husked seeds yield, according to Cloëz, 36·20 per cent. of oil. (*Compt. Rend.* LXI., p. 236.)

Moringa bark contains a white crystalline principle answering to the reactions of an alkaloid and occurring in the spirituous extract. It is scarcely soluble in water and ether, but readily soluble in acidulated water, alcohol and chloroform. Sulphuric acid dissolves it with a red-brown colour, nitric acid with a yellow colour. The bark also contains two resins, one soluble the other insoluble in ammonia, an organic acid, a quantity of mucilage, and it left on incineration 8·2 per cent. of carbonated ash. An alcoholic extract of 30 grammes of bark was administered to a small dog and produced no poisonous effects. The gum-like exudation when placed in water gradually disintegrates, forming a slimy mucilage which is precipitated white by solutions of neutral and basic plumbic acetate, and is not affected by alcohol, ferric chloride, oxalate of ammonia or borax. The insoluble portion is seen under the microscope to be composed of mucilage cells. No starch or tannin is present in the exudation. When holding 11 per cent. of water it has a specific gravity of 1·46 at 15° C. It absorbs 20 times its weight of nitric acid (1·2), forming an orange jelly which when heated is decomposed and produces oxalic acid. Ash 2·75 per cent.

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LEGUMINOSÆ.

CROTALARIA JUNCEA, *Linn.*

Fig.—*Roxb., Cor. Pl. t.* 193 ; *Bot. Mag.* t. 1933; *Rheede, Hort. Mal. ix. t.* 26.

Hab.—Throughout the plains of India. Often cultivated.

Vernacular.—San (*Hind., Beng., Guz.*), Jenappa, Shanal (*Tam.*), Shanambo (*Tel.*), Sanvu (*Can.*), Tág, Sonalla (*Mar.*).

History, Uses, &c.—The seeds and leaves of this plant, in Sanskrit Sana, are used in Hindu medicine, and are considered to be cooling, and to purify the blood in febrile states of the system accompanied by cutaneous eruptions, such as impetigo, psoriasis, &c. They are also said to be emmenagogue in half drachm doses given twice a day, and are supposed sometimes to have caused abortion, but this is very improbable. The sacred thread of the Kshatrias is directed by Manu to be made of Crotalaria fibre.

C. verrucosa, *Linn., Bot. Mag. t.* 3034; *Wight, Ic. t.* 200; *Rheede, Hort. Mal. ix. t.* 29, found throughout the tropical regions of India, is called in Sanskrit Sana-pushpi, Dhavani, and Vrihat-pushpi; it is described in the Nighantas as bitter and an expellant of bile and phlegm. This plant and several other species of the genus are included under the Sanskrit name of Ghantarává and the vernacular names Jhaujhania (*Hind., Beng.*), Vatta-killu-killuppai (*Tam.*), Ghelegherinta (*Tel.*), Ghágri, Dingala, Khúlkhúl-dingala (*Mar.*), in allusion to the rattling noise made by the seeds when the ripe pods are shaken, just as the generic name of the botanists is derived from the Greek κρόταλον, a rattle or castanet. Rheede (*Hort. Mal. ix.* p. 53) says that the juice of the leaves of *C. verrucosa* is supposed to diminish salivation. Ainslie, speaking of the same plant, says:—"The slightly bitter, but not unpleasant tasted juice of the leaves and tender stalks is prescribed by the Tamool doctors, both internally and externally, in cases of scabies and

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impetigo." In Pudukota, **C. retusa**, *Linn.* (*Bot. Mag. t.* 2561; *Rheede, Hort. Mal. ix. t.* 25), is used for the same purpose. **C. sericea**, *Retz.*, is used in Bengal, and **C. medicaginea**, *Lam.*, in the Punjab. **C. Burhia**, *Hamilt.*, called Khip, Sis and Kharsan in the vernaculars, is considered to be very cooling; it is a naked-looking, bushy plant, common in the arid districts of Northern India, which has the smell of broom when bruised.

C. juncea is extensively cultivated for its fibres, from which tow is prepared. The nets of the Bombay fishermen are made of this fibre which is very strong and tans well. After the bark has been removed, the stems of the plant, which are perfectly straight and unbranched, are sold to the toy-makers; or cut in short lengths and dipped in brimstone to make fire-lighters for the Parsees, whose religion forbids them to blow fire when lighting or extinguishing it.

The Crotalarias appear to be used medicinally on account of their mucilaginous and emollient properties; the leaves might be used as a poultice like Althæa leaves.

Chemical composition.—Mr. J. G. Prebble, who has examined the leaves of *C. retusa* and *C. medicaginea*, informs us that they contain abundance of mucilage, a little solid fat, and a resin soluble in ether, which does not form a reddish solution with potash. The leaves of *C. medicaginea* contain also a trace of tannin.

TRIGONELLA FŒNUM-GRÆCUM, *Linn.*

Fig.—*Sibth., Fl. Græc., t.* 766; *Bentl. and Trim., t.* 71. Fenugreek (*Eng.*), Fenugrec (*Fr.*).

Hab.—Cashmere, Punjab, Upper Gangetic Plain. Widely cultivated. The seed and herb.

Vernacular.—Méthi (*Hind., Mar., Guz., Beng.*), Vendayam (*Tam.*), Mentula (*Tel.*), Menthya, Mente (*Can.*).

History, Uses, &c.—Fenugreek has a history of great antiquity; it was much valued by the ancients both as a food and medicine; in India it has long been extensively cultivated, its seeds being considered carminative, tonic, and aphrodisiac. Several confections made with them are described in Sanskrit works under the names of *Methi modaka*, *Svalpa methi modaka*, &c., and are recommended for use in dyspepsia with loss of appetite, in the diarrhœa of puerperal women, and in rheumatism. All these preparations consist of a number of aromatic substances, one part each, and fenugreek seeds equal in quantity to all the other ingredients. Under the Arabic name of Hulbah, and the Persian Shamlit, Mahometan writers describe the plant and seeds as hot and dry, suppurative, aperient, diuretic, emmenagogue, useful in dropsy, chronic cough, and enlargements of the spleen and liver. A poultice of the leaves is said to be of use in external and internal swellings and burns, and to prevent the hair falling off. The flour of the seeds is used as a poultice, and is applied to the skin as a cosmetic. They also use the oil of the seeds for various purposes. In Europe the history of the plant is equally ancient. Aretæus prescribed it both internally and externally. The powder of the seeds was recommended by Dioscorides in the form of a poultice for inflammatory affections.* Pliny (24, 120) mentions the use of Fenugreek or Silicia as a medicine, and ascribes to it the same properties as the Mahometan writers above quoted. Ainslie notices its uses by native practitioners in Southern India for dysentery, the seeds being toasted and afterwards infused. At the present time, Fenugreek is extensively used in India both as an article of diet and as a medicine. The leaves are used both internally and externally on account of their cooling properties. The young plants are always to be found in the vegetable markets, and are most esteemed when only the two seed leaves are formed; they are boiled and afterwards fried in butter, the taste is strongly bitter, and disagreeable to those who have not become accustomed to it; in bilious states of the system the vegetable has an aperient action. The seeds enter into the composition of an imitation of carmine. The yellow decoction used with sulphate of copper produces a fine permanent green. In modern medicine Fenugreek is no longer in use; it is, however, still kept by druggists for veterinary pharmacy, and is very largely consumed in the preparation of cattle foods.

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* It is the *τηλις* of Dioscorides (ii., 93). Other Greek names are *βούκερως*, (oxhorn) and *αἰγόκερως* (goatshorn).

Description.—The pod is sickle-shaped, 3—4 inches long, slightly flattened and ending in a long point; it contains from 10—20 rhomboidal seeds, yellow or yellowish-brown, semi-transparent, about ⅛ of an inch long, somewhat compressed, with the hilum on the sharper edge, and a deep furrow running from it and almost dividing the seed into two unequal lobes; the surface is finely tubercular; the testa consists of two layers, the inner of which is mucilaginous and encloses the cotyledons and their large hooked radicle. The cotyledons are composed of parenchymatous tissue, the cells of which contain globules of fatty matter, and granular matter coloured yellow by iodine; the taste is bitter, oily and aromatic.

Chemical composition.—The cells of the testa contain tannin; the cotyledons a yellow colouring matter, but no sugar. The air-dried seeds give off 10 per cent. of water at 100° C., and on subsequent incineration leave 7 per cent. of ash, of which nearly a fourth is phosphoric acid. Ether extracts from the pulverised seeds 6 per cent. of a fetid, fatty oil, having a bitter taste. Amylic alcohol removes in addition a small quantity of resin. Alcohol added to a concentrated aqueous extract, forms a precipitate of mucilage, amounting, when dried, to 28 per cent. Burnt with soda lime, the seeds yielded to Jahns 3·4 per cent. of nitrogen, equivalent to 22 per cent. of albumin. The nature of the odorous principle has not been determined. (*Pharmacographia.*) E. Jahns (*Bericht*, 18, 2518-2523) reports that he has found two alkaloids in the seeds, *choline*, a base found in animal secretions, and another, which he names *trigonelline*. The pulverised seeds were extracted with 70 per cent. alcohol, and after evaporation, the residual liquor was precipitated with lead acetate and soda. After removal of lead from the filtrate and evaporation, the alkaloids were precipi-

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tated by potassium-bismuth iodide and sulphuric acid. The bases were only completely precipitated after some weeks, and were then converted into the mercuric iodide compounds to separate albuminous matter. This was done by decomposing the bismuth compound with soda and adding mercuric iodide, when *choline* was precipitated and *trigonelline* remained in the mother liquor, from which it was precipitated as oily drops (afterwards solidifying) by means of sulphuric acid —0·05 per cent. of choline and 0·13 per cent. of trigonelline were obtained. The author examined the gold and platinum salts of choline. Trigonelline, $C^7 H^7 NO^2 + H^2 O$, crystallises from alcohol in colourless prisms, which possess a weak saline taste. It is hygroscopic and easily soluble in water, but is insoluble in ether, chloroform, and benzol. The solutions are neutral. It gives precipitates with the usual alkaloidal reagents. Analyses of the free base, the hydrochlorate and the platinum and two gold double salts were made.

Trigonelline is isomeric and probably identical with pyridine-betäin, prepared by Von. Gerichten by heating pyridine with monochloracetic acid, the only difference being that pyridine-betäin hydrochlorate is coloured blue by sodium amalgam, and trigonelline yellow. By heating trigonelline with concentrated caustic potash, a distillate is obtained which appears to contain pyridine. (*Journ. Soc. Chem. Ind., Journ. de Phar. et de Chim.*, 1886.)

Commerce.—Fenugreek seeds are grown extensively in the higher inland provinces of India. From Karachi alone the imports into Bombay are about 14,000 cwts. annually.

Value.—Rs. 43 to 50 per candy.

TRIGONELLA UNCATA, *Boiss.*

Hab.—Persia. The pods.

Vernacular.—Iklil-el-malik (*Arab., Ind.*).

History, Uses, &c.—The small crescent-shaped pods which are imported into Bombay from the Persian Gulf under this name are considered by Arabian writers to be the Meli-

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lotus of Dioscorides.* The author of the Makhzan-el-Adwiya gives Málilotus as the Greek name and Giah-i-kaisar as the Persian. He goes on to say that "there are two kinds of melilot, both plants are much alike, but the fruit of one is crescent-shaped with small roundish seeds something like fenugreek, while the fruit of the other is much smaller and only slightly curved; both have an odour like fenugreek. The best fruit for medicinal purposes is hard, yellowish, white and aromatic, with yellow seeds." The Mahometans, following the Greeks, hold melilot in high esteem as a remedy in a great variety of disorders; it is considered to be suppurative and slightly astringent, and is much used as a plaster to dispel tumours and cold swellings. The diseases in which it is administered internally are of a widely different nature and far too numerous for recapitulation here; for an account of them we must refer the reader to the Makhzan, article Iklíl-el-malik. *Melilotus alba*, Lam., and *M. parviflora*, Desf., grow in India; the first species has the delicate odour of the European melilot. In the Makhzan an Indian variety of melilot is mentioned, which has very small fruit; it is called Pirang.† Coumarin, the odorous principle of melilot, when given to dogs in doses of 7 to 10 grains, produces great and even fatal depression, and in man doses of 30 to 60 grains occasion nausea, giddiness depression, vomiting and drowsiness. Köhler finds it to be a narcotic, which at first stimulates, but afterwards paralyzes the heart.

Description.—Small, sickle-shaped, greyish yellow pods with a beak slightly curved outwards, distance from base to apex ½ an inch; length of pod round the curve about one inch; it is grooved on both sides, and divided by a central partition into two cells, each of which contains a single row of small greyish-yellow rhomboidal seeds, deeply notched on one side, and seen under the microscope to be marked with numerous black spots. The other kind with very small slightly curved pods mentioned by Mahometan writers is not found in the shops.

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* μελίλωτος, Dios. iii., 43. Melilotus and Sertula campana of the Romans. Plin. 21, 29, much used in preparing malagmata, Scrib. Comp. 258, *et seq.*

† *Trigonella corniculata*, Linn., Wight Ic. t. 384. It is cultivated in Bengal as a vegetable in the cold weather, also at Belgaum, where it is called *Tirapa*. It is the Málya of Sanskrit writers, and is used in India for making chaplets.

Chemical composition.—Coumarin, $C^9 H^6 O^2$, the anhydride of coumaric acid, $C^9 H^8 O^3$, and the odorous principle of melilot, is found in several plants; it is best prepared from the Tonka bean, *Coumarouna odorata*, by digesting in strong alcohol, on evaporating, a crystalline magma is obtained, which when purified with animal charcoal is colourless; it crystallizes in trichlinic crystals; melts at 50° C., and boils at 270° without sensible alteration; it has an agreeable aromatic odour, and a bitterish burning taste, the vapour acts strongly upon the brain; coumarin is nearly insoluble in cold water, boiling water dissolves it freely, and deposits it on cooling in slender needles. It dissolves without alteration in dilute acids.

Commerce.—Iklil-el-malik is sold for six annas per lb.

INDIGOFERA TINCTORIA, *Linn.*

Fig.—*Rheede, Hort. Mal. i., t.* 54; *Wight Ic. t.* 365. Dyer's Indigo (*Eng.*), Indigotier tinctorial (*Fr.*),

Hab.—Western India, cultivated elsewhere. The plant and Indigo.

Vernacular.—Nil (*Hind., Beng.*), Nili (*Mar., Can.*), Nilam (*Tam.*), Nili-mandu (*Tel.*), Gali (*Guz.*).

History, Uses, &c.—Indigo, in Sanskrit Nila, a word which signifies dark blue or black, appears to have been known in the East as a dye and medicine from a very remote period. Its importance as an article of trade is indicated by the Sanskrit synonym Banigbandhu, or "trader's friend." It was probably exported from Cambay, Broach and Thana at a very early period, certainly from the latter port B. C. 30. What

Dioscorides calls Indicon, and Pliny and Vitruvius Indicum, was a blue pigment brought from India, and used both in painting and dyeing. When powdered it gave a black powder, and when suspended in water it produced an agreeable mixture of blue and purple. It belonged to the costly dye-stuffs, and was often adulterated by the addition of earth. On this account, that which was soft without any roughness, and which resembled an inspissated juice, was esteemed the best. Both Pliny and Dioscorides speak of two kinds, one of which adheres to reeds, in the form of slime or scum thrown up by the sea; the other was scraped from the sides of dye-pans in the form of a purple-coloured scum. The ancients considered Indicum to be astringent, and used it for ulcers and inflammation, and to cleanse and heal wounds. (See Beckmann's Hist. of Invent. II., p. 258, where the subject is fully discussed.) The early Arabian physicians identified Indicum with Nil, which they regarded as a kind of Indian woad. Ibn Sina calls it El-wasmah-el-Hindiya, and it was also called Idlim, which was an Arabian name for woad, as appears from a passage in Abu Hanifeh, who says:—"An Arab of the desert, of the Saráh tribe, told me that the Idlimeh is a plant that rises upon a stem about a cubit in height, and has branches at the extremities of which are what resemble the blossoms of the coriander, and it (the plant) is dust-coloured." In Ibn Sina's time woad appears to have been superseded by indigo, as he describes wasmeh as wark-un-nil, "or leaves of the Nil." In the 13th century, Marco Polo relates that he saw Indigo, which the dyers used, made in the kingdom of Coulan or Coilum; and he describes the process for preparing it. Persian writers on Indian drugs state that before the time when the English began to cultivate indigo, the best kind made in India was known as Baiana, from the name of a place in the Shahjehanabad district where it was made, and the record of the cargoes of the ships which arrived in Holland from the East Indies in 1631, show that the first had 13,539 lbs. of Sirches indigo; the second 82,734 lbs. of Guzerat indigo; the third 66,996 lbs. of the same; the fourth 50,795 lbs. of *Bajana* indigo; the fifth 32,251 lbs. of Sirches indigo; the sixth 59,698 lbs. of *Bajaña* indigo; and the seventh 27,532 lbs. of Sirches. The value of the indigo brought in these ships was at least 500,000 dollars.

The indigo plant was not known in Europe until the close of the 16th century.

Both Hindus and Mahometans consider the plant to have attenuant properties; they prescribe it in whooping-cough, affections of the lungs and kidneys, palpitation of the heart, enlargement of the spleen or liver and dropsy. Indigo applied to the navel of children is said to act upon the bowels; it is applied to the hypogastrium to promote the action of the bladder.

A poultice or plaster of the leaves is recommended in various skin affections, and is used as a stimulating application to old ulcers, haemorrhoids, &c. Indigo is applied to the bites and stings of venomous insects and reptiles to relieve the pain, also to burns and scalds, and in Bengal is commonly applied to wounds, &c., of horses and cattle.

The plant has a great repute in some parts of India as a prophylactic against hydrophobia, so much so as to be known among the natives as "*the dog-bite shrub.*" A wineglassful of the juice of the leaves is administered in the morning, with or without milk, for three days, to those who have been bitten by dogs supposed to be mad. People who have taken it inform us that beyond slight headache no disagreeable effect is produced, but that when a larger dose has been given it has proved purgative. In addition to the internal administration, the expressed leaves are each day applied to the bitten part as a poultice. Rheede, speaking of indigo, says—"viribus veneni obsistit." Ainslie notices the use of the root by the Hindus in hepatitis. It would appear that the wild indigo (*I. paucifolia*, Delile,) is considered to have the same medicinal properties as *I. tinctoria* and its variety *I. anil*. For Roth's observations on the use of Indigo in epilepsy and other spasmodic affections, see *Brit. and For. Med. Rev.*, July 1836, p. 244. His account

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of its physiological effects is as follows :—"Shortly after taking it, the patient experiences a sense of constriction at the fauces, and the impression of a metallic taste on the tongue. These are followed by nausea, and frequently by actual vomiting. The intensity of these symptoms varies in different cases. In some the vomiting is so violent as to preclude the further use of the remedy. The matter vomited presents no peculiarity except its blue colour. When the vomiting has subsided, diarrhœa usually occurs: the stools are more frequent, liquid, and of a blue or blackish colour. The vomiting and diarrhœa are frequently accompanied by cardialgia and colic. Occasionally these symptoms increase, and the use of the remedy is in consequence obliged to be omitted." Dyspepsia and giddiness sometimes succeed. The urine has a brown, dark, violet colour; but Dr. Roth never found the respiratory matter tinged with it. After the use of indigo for a few weeks, twitchings of the muscles sometimes were observed, as after the use of strychnia. The seeds of these plants powdered and steeped in arrack or rum, yield a tincture which is used to destroy lice.

Cultivation and production.—Indigo is chiefly cultivated in Bengal in the delta of the Ganges, on those districts lying between the Hooghly and the main stream of the former river. The ground is ploughed in October and November after the cessation of the rains; the seeds are sown in March and the beginning of April. In July the plants are cut when in blossom, that being the time when there is the greatest abundance of dyeing matter. A fresh moist soil is the best, and about 12 lbs. of seeds are used for an acre of land. The plants are destroyed by the periodical inundations, and so last only for a single year. The cut plants are first steeped in water, when they ferment with evolution of CO^2, the yellow liquor is then run off into another vat, when it is vigorously mixed with air by manual labour or machinery. By this means the leucindigo (white indigo) contained in the solution is oxidised, and the indigo separates out as a blue scum which finally settles to the bottom. The supernatant liquor is then run off, and the indigo is boiled with water for several hours, pressed and dried. (*Watts' Dict. of Chem.*) Before it is perfectly dry it is cut into cubes three inches square; it is then packed up for sale. Indigo is one of the most precarious of Indian crops, being liable to be destroyed by insects as well as inundation of the rivers. It is generally divided into two classes, *viz.*, Bengal and Oude indigo. Madras indigo is not much inferior to that grown in Bengal.

Description.—A shrub 2 to 3 feet, erect, pubescent; branches terete, firm; leaves pinnated; leaflets 5 to 6 pairs, oblong ovate, cuneate at the base, slightly decreasing in size towards the apex; racemes shorter than the leaves; sessile, many flowered; flowers small, approximated at the base of the raceme, more distant and deciduous towards the apex, greenish rose-coloured; calyx 5 cleft; segments broad, acute; legumes approximated towards the base of the rachis, nearly cylindrical, lightly torulose, deflexed and curved upwards; seeds about 10, cylindrical, truncated at both ends.

Chemical composition.—The formation of leucindigo from the glucoside indican, which is present in the plant, is stated by E. Alvarey (*Compt. Rendus.* 105, 286) to be effected by a special bacillus, which is strongly pathogenic, and closely resembles the bacilli of pneumonia and rhinoscleroma (*Watts' Dict. of Chem.*) Regarding the preparation of indigo synthetically by Baeyer, and for an account of the chemistry of the article, we would refer our readers to Muir and Morley's edition of Watts' *Dictionary of Chemistry.* Pure indigo should yield about 4·5 per cent. of ash.

Commerce.—There are many kinds of indigo in the Indian market; the principal are:—

Calcutta	Value Rs.	60 to 110	per maund	of 41 lbs.
Madras	„ „	40 „ 105	„	„
Hawudi	„ „	55 „ 66	„	„
Kheirpuri	„ „	38 „ 50	„	„
Multanilál	„ „	35 „ 50	„	„
Kánpúr	„ „	30 „ 50	„	„
Deráni Jámpúr...	„ „	20 „ 32	„	„

The present annual production of indigo is estimated as about 8,200 tons (value £ 4,000,000), of which 6,100 tons are produced in India, 1,100 tons in America, and 1,000 tons in China and other countries. (*Watts' Dict. of Chem.*)

INDIGOFERA ASPALATHOIDES, *Vahl.*

Fig.—*Wight Ic., t.* 332 ; *Hook. Ic., t.* 188.

Hab.—Carnatic and Ceylon. The plant.

Vernacular.—Shenevar-vaymbu (*Tam.*), Shiva-nimb (*Mar.*).

History, Uses, &c.—This plant is the Manelli of Rheede (*Hort. Mal. ix.*, 37) and the *Aspalathus indicus* of Ainslie. Rheede states that the plant, rubbed into a paste with butter, is applied to reduce œdematous tumours, and that a preparation made from the ashes of the burnt plant is used to remove dandriff from the hair ; the leaves are applied to abscesses, and an oil is prepared with the root which is used to anoint the head in erysipelas. According to Ainslie, the leaves, flowers, and tender shoots are considered to be cooling, demulcent, and alterative, and are employed in decoction in leprosy and cancerous affections. The root is chewed as a remedy for toothache and aphthæ of the mouth.

Description.—A low undershrub, with many spreading, rigid, terete branches, and argenteo-canescent branchlets. Leaflets 1 to 5, pale green, with a few obscure adpressed hairs, oblong-lanceolate, $\frac{1}{12}$ to $\frac{1}{4}$ in. long, often complicate. Pedicels erecto-patent, $\frac{1}{8}$ to $\frac{1}{4}$ inch. Corolla pale red. Pod straight, glabrous, turgid, $\frac{1}{2}$ to $\frac{5}{8}$ in. long, 6 to 8 seeded. (*Fl. Brit. Ind.*)

Indigofera paucifolia, *Delile.* Kuthekar, Summattee (*Tam.*), is a rare shrub, the leaves of which are covered with a hoary pubescence. Dr. P. S. Mootooswamy informs us that it is used for rheumatic affections, and that the native physicians consider it to be antiphlogistic, antisyphilitic, and deobstruent. The whole plant is cut in small pieces and stewed for several days in the oven, and the resulting decoction is used to foment the joints, and a dose of from 3 to 4 ounces is administered internally twice a day. A decoction of the root is also used as a remedy for periostitis. It is made with 2 ounces of the powdered root and 10 ounces of water boiled down to one half. Dose 1 to 2 ounces.

Indigofera enneaphylla, *Linn., Wight. Ic., t.* 403; *Burm. Fl. Ind., t.* 55, *f.* 1. Kennegilu (*Can.*), Adambedi (*Tam.*). According to Ainslie, the juice of this plant is given as an anti-scorbutic, alterative and diuretic. It is called Bhui-guli in Marathi.

Indigofera trifoliata, *Linn., Wight Ic., t.* 314. The seeds, which are oblong, about $\frac{1}{16}$ of an inch long, polished, yellowish and marked with minute dull red blotches, are prescribed along with other mucilaginous drugs as a restorative. They are called Vekário in Guzerathi.

PSORALIA CORYLIFOLIA, *Linn.*

Fig.—*Burm. Fl. Ind., t.* 49; *Bot. Mag., t.* 665.

Hab.—Himalaya to Ceylon. The seeds.

Vernacular.—Bukchi, Bábachi (*Hind.*), Bavachi (*Mar.*), Latakasturi (*Beng.*), Karpo-karishi (*Tam.*), Bhavanchi-vittulu, Káru-bogi vittulu (*Tel.*)

History, Uses, &c.—Sanskrit writers mention a plant called Lata-kasturika or Lata-kasturi as growing in the Deccan; it has been supposed by most modern writers on Indian Materia Medica to be the Musk Mallow; but as that plant does not grow in the Deccan, and *P. corylifolia* is very common there and is known in Bengal as Lata-kasturi, we think it probable that it is the plant alluded to, especially as the seeds are used in making a perfumed oil which is applied to the skin. Native works on Materia Medica describe the seeds as hot and dry, or according to some, cold and dry, lenitive, fragrant, stimulant and aphrodisiac. They are recommended in leprosy, and other chronic skin diseases which depend upon

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a vitiated state of the blood, and are given internally and applied externally as a plaster; whence the synonym Kushtanásini; they are also said to be useful in febrile bilious affections and as an anthelmintic and diuretic. The Hindus class them with the रसायान (*rasáyán*) or alchemic drugs. Ainslie mentions their use in Southern India as a stomachic and deobstruent, and says that they are prescribed in lepra and other inveterate cutaneous affections. Some years ago the seeds were extensively tried in Bombay by Dr. Bhao Dáji and others, as a remedy in leprosy, with some success.

Dr. Kanny Loll Dey strongly recommends the oleo-resinous extract of the seeds diluted with simple unguents as an application in leucoderma. He says:—"After application for some days the white patches appear to become red or vascular; sometimes a slightly painful sensation is felt. Occasionally some small vesicles or pimples appear, and if these be allowed to remain undisturbed, they dry up, leaving a dark spot of pigmentary matter, which forms as it were a nucleus. From this point, as well as from the margin of the patch, pigmentary matters gradually develope, which ultimately coalesce with each other, and thus the whole patch disappears. It is also remarkable that the appearance of fresh patches is arrested by its application." (*Phar. Journ., Sept. 24th*, 1881.) In the hands of other observers, however, only negative results have been obtained by this mode of treatment.

Several species of Psoralia have been used medicinally in America, and have been found to act as gentle, stimulating, and tonic nervines. (For an interesting account of the American Psoralias, see Maisch., *Amer. Journ. Pharm., July* 1889.)

Description.—The seeds are oblong and flattened, rough, dark brown, about 2 or 2½ lines in length; they are unctuous to the touch, and have an agreeable aromatic odour exactly resembling that of the bael fruit and very similar to elemi; the taste is aromatic and bitterish.

Chemical composition.—The seeds reduced to fine powder and heated to 100° C. for 5 hours lost 5·01 per cent. in weight,

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but the powder still possessed the aromatic odour of the drug. The ash amounted to 7·41 per cent.; it contained a trace of manganese. On distilling the powdered seeds with water, a colourless oil was obtained, lighter than water, and which possessed in a very marked degree the odour of the seeds. The powdered seeds digested with light petroleum ether yielded 13·26 per cent. of a dark amber-coloured, thick non-crystalline extractive, which had a strong odour of the drug. By the action of cold 96 per cent. alcohol the extract was separated into a portion soluble in alcohol and an insoluble residue. The insoluble residue consisted of yellow oily matter which could be easily saponified with alcoholic potash. The portion soluble in alcohol was of a dark, reddish colour, and the alcoholic solution had a marked acid reaction. After driving off the alcohol the soft extract was treated with caustic soda and agitated with ether. The ethereal solution left on evaporation an oily reddish non-crystalline residue, with a somewhat sweet taste. The aqueous alkaline solution was treated with hydrochloric acid in slight excess, which threw down a yellow precipitate, and the solution agitated with light petroleum ether. With the exception of a few brown flocks, the precipitate produced by the acid was wholly dissolved by the petroleum ether. On spontaneous evaporation of the ether a bright yellow oily residue was left; taste somewhat bitter like that of the seeds. This oily residue was soluble in alcohol; on spontaneous evaporation small needle-shaped crystals separated. Ferric chloride added to an alcoholic solution produced a dark brown coloration. After the action of light petroleum ether, ether extracted 7·1 per cent. of a reddish-yellow hard varnish-like extract with a very faint odour of the seeds; easily soluble in alcohol with neutral reaction, insoluble in water, or in dilute hydrochloric acid; partly soluble in aqueous ammonia, but easily soluble in dilute caustic soda, forming a dark, reddish solution. The addition of acids caused the precipitation of yellow flocks; an alcoholic solution was coloured dark brown by ferric chloride. After exhaustion of the powdered seeds with ether, absolute alcohol yielded 6·12 per cent. of extractive, partly soluble in

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water, with acid reaction and yellow colour. The portion insoluble in water was of a dark colour. The addition of dilute HCl to the aqueous solution caused the precipitation of yellow flocks. The solution filtered from these yellow flocks gave a slight precipitate with phosphomolybdic acid, but no reaction with other alkaloidal reagents. The addition of alkalies deepened the tint of the solution, but no tannin reaction could be obtained.

To cold distilled water, the residue after the action of absolute alcohol yielded 19·34 per cent. of extractive which contained albumen, sugar, &c., and a trace of an organic acid.

TEPHROSIA PURPUREA, *Pers.*

Fig.—*Rheede, Hort. Mal. i., t.* 55; *Bert. Misc. xix.*, 9, *t.* 5. Purple goat's rue (*Eng.*), Tephrosia pourpre (*Fr.*).

Hab.—Tropical zone. The plant.

Vernacular.—Sarphunkha, Sarpunkha (*Hind.*, *Guz.*), Bon-nil-gachh (*Beng.*), Unháli (*Mar.*), Kolluk-kay-velai (*Tam.*), Vempali (*Tel.*).

History, Uses, &c.—Sarapunkha, the Sanskrit name of this plant, is a compound of शर, an arrow, and पुंख, the pinion of an arrow, in allusion to the pinnate leaf of the plant. Native works on Materia Medica describe it as hot and moist, some say cold; it is considered to be deobstruent and diuretic, useful in cough and tightness of the chest, bilious febrile attacks, obstructions of the liver, spleen, and kidneys; they recommend it as a purifier of the blood, and for boils, pimples, &c. Mir Muhammad Husain describes the plant minutely, and mentions its use in combination with *Cannabis indica* leaves (bhang), two parts of the former to one of the latter, in powder, as a remedy for bleeding piles; given with black pepper he says it is diuretic, and especially useful in gonorrhœa. Ainslie says the root of *Galega purpurea* is prescribed by the native practitioners of Southern India in decoction in cases of dyspepsia and tympanitis, and we have noticed a similar use of the plant

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in Western India. *T. purpurea* is a common weed in the rainy season; the whole plant is pulled up when in flower and seed, and tied in bundles of about a handful for sale. In Pudukota the juice of the leaves of **T. villosa** (Vaykkavalai in Tamil) is given in dropsy. In America the roots of *T. virginiana*, Pers., are considered to be laxative, tonic and vermifuge, and have also been reported to be useful in typhoid fever; a decoction made with an ounce of the plant to a pint of water and boiled down to one half, has been used in doses of one to two tablespoonfuls. (*Stillé and Maisch.*)

Description.—A shrubby, erect, much-branched plant about 2 feet high; leaves pinnated; leaflets 5 to 9 pairs with an odd one, the largest an inch long, and 3-10th of an inch broad, cuneate oblong; racemes peduncled, longer than the leaves; legumes slightly compressed, spreading, linear falcate, obtuse, with a short point; seeds 4 to 6 in each pod, small, kidney-shaped; testa mottled; cotyledons yellow. All parts of the plant are slightly bitter.

Chemical composition.—The whole plant, with seeds, pods, but no roots, dried by exposure to air and reduced to fine powder, lost 8·44 per cent. when heated to 100° C. The ash amounted to 6·07 per cent., and contained a trace of manganese.

The petroleum ether extract amounted to 2·88 per cent., and consisted of chlorophyll, a resin and a trace of wax. Ether extracted 1·05 per cent., the extract consisted chiefly of a brown resin and chlorophyll. Treated with dilute hydrochloric acid a trace was dissolved. No reactions were afforded by alkaloidal reagents.

The absolute alcohol extract amounted to 2·36 per cent., on spontaneous evaporation yellowish nodules separated; these were washed with cold alcohol, and then dissolved by boiling alcohol. On evaporation, a sulphur-yellow powder and crusts separated, which examined microscopically, consisted of needle-shaped crystals. These crystals were soluble in boiling water, but practically insoluble in cold water, alcohol or ether; ferric-chloride gave a green colouration in an aqueous solution, which turned dirty red on boiling. In alkalies these crystals were soluble, the solution being of a bright yellow colour; acetate of lead gave a bright yellow precipitate; an aqueous solution had an acid reaction, and at once reduced nitrate of silver. This principle would appear to be allied to quercitrin or quercetin. The absolute alcohol extract treated with acidulated water did not give any reaction with the usual alkaloidal re-agents.

Cold water extracted 14·20 per cent., the extract contained gum, a trace of albumin and colouring matter, but did not reduce an alkaline solution of sulphate of copper.

Mundulea suberosa, *Benth., Bedd. Fl. Sylv.* 85; *Hook. Ic. Plant., t.* 120, Syn.—*Tephrosia suberosa,* is a stout, erect shrub growing in hill valleys in the Western Peninsula and Ceylon. It is frequently cultivated in gardens on account of its beautiful rose-coloured flowers, which form terminal racemes. The leaves resemble Senna leaves. The seeds are used in Southern and Western India as a fish poison. They stupefy the fish, which are then readily taken by the hand.

The pods are about 4 inches long, straight, silky, contracted between the seeds, with both sutures thickened so as to form prominent borders; seeds 6 to 8, kidney-shaped, laterally compressed, about $\frac{3}{6}$ in. in length and $\frac{2}{6}$ in. in breadth, of a pale dull yellow colour. Beneath the thick, fissured, soft corky bark of the stem is a compact inner bark of a green colour, which has a bitter taste and has the same effect upon fish as the seeds.

Mundulea seeds and bark contain a greenish yellow resin soluble in carbon bisulphide, benzol, chloroform, amylic alcohol, ether, hot alcohol, and partly in caustic alkalies with a bright yellow colour.

The leaves contain besides the resin an organic acid and 9 per cent. of ash.

ALHAGI MAURORUM, *Desv.*

Fig.—*Jaub. & Spach. Ill., t.* 401. Camel thorn (*Eng.*), Alhagi Manne (*Fr.*).

Hab.—N.-W. Provinces, Upper Gangetic plain and Concan. The plant and manna.

Vernacular.—The plant, Jawása (*Hind.*), Javaso (*Guz.*), Girikarmika (*Tel.*) ; the manna, Taranjabin.

ALHAGI CAMELORUM, *Fisch.*

Hab.—Khorasan. The Manna.

Vernacular.—The plant, Khár-i-buz, Khar-i-shutr (*Pers.*) ; the manna, Taranjabin.

History, Uses, &c.—These plants, in Sanskrit Durálabha (difficult to be laid hold of), in Persian Khár-i-buz or Khár-i-shutr, and in Arabic Háj, or Algoul, are natives of the deserts of Egypt, Syria, Mesopotamia, Persia, and India as far south as the Concan, and have been supposed by some to be the Occhi of Pliny, and the ἄκάνθά ἐν 'Αρία or ' Khorasan Thorn' of Theophrastus.* Mahometan writers give Farákiyun or Atháriyun as the Yunáni names, both evidently post-classical ; the first appears to be derived from φέρω to bear and ἀκή, a a point or dart, and the second from ἀθήρ a spike or spine. A Persian manna probably obtained from these plants is mentioned by Polyænus, A. D. 163, under the name of ὕον μέλι.

In the hot season when all the smaller plants die they send forth leaves and flowers. The generic name is derived from the Arabic Al-hàju, which is pronounced by the Egyptian Arabs El-hágu. The plants are described in Sanskrit works as laxative, diuretic and expectorant, the thorny flower stalks and branches being the parts used. An extract obtainable by evaporating a decoction of *A. Maurorum* is called Yávasakará ; it has a bitter sweet taste, and is used as a demulcent in coughs. There is no mention in Sanskrit books of manna being obtained from the plant ; indeed none is produced upon it in India. The Hindus use the fresh juice as a diuretic, generally in combination with laxatives and aromatics. (Cf. *Sarangadhara and Chakradatta.*) In Mahometan works, under the names of Háj and Khár-i-shutr, or camel thorn, a description of the plants will be found. They are considered to be aperient, attenuant and alexipharmic. A poultice, or fumigation with them is recommended to cure piles, the expressed juice is applied to opacities of the cornea, and is directed to be snuffed up the nose as a remedy for megrim. An oil is prepared with the leaves as an external application in rheumatism ; the flowers are applied to remove piles. Ainslie notices *A. Maurorum* as one of the sources of manna. In the Bengal Dispensatory and Pharmacopœia of India it is also noticed on this account. Under the name of Taranjabín Mahometan writers describe Alhagi manna. Mir Muhammad Husain says that it is collected in Khorasán, Mawarunnahr, Kurjistan, and Hamadan by cutting the plants and shaking them in a cloth to separate the manna. According to Aitchison the country round Rui-Khauf is famous for this manna. An inferior kind is made by dissolving what still adheres in water and evaporating it to a suitable consistence. He describes it as aperient and cholagogue, more digestible than *Shirkisht*, expectorant, a good purifier of the blood from corrupt and adust humours when given in diet drinks such as barley water, &c. ; diuretic, and with milk, fattening and aphrodisiac. In Bombay fine clean white samples of Taranjabin are sometimes obtainable during the season of import (November to January), but unless very carefully preserved it soon spoils in the moist climate of the Western Coast, running together, and becoming a brown sticky mass. The dried plant of *A. Maurorum* is always obtainable under the name of Jawása, and the ripe fruit with manna adhering to it under the name of Taranjabín. In the Concan the plant is smoked along with Black Datura, Tobacco, and Ajwán seeds as a remedy for asthma.

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* ἐν δέ τη 'Αρία χώρα καλουμένη ἄκανθά ἐστιν ἐφ' ἧς γίνεται δάκρυον ὅμοιον τῆ σμύρνη και τῆ ὄψει καί τῆ ὀσμῆ. τοῦτο δὲ ὅταν ἐπιλάμψη ὁ ἥλιος καταρρεῖ» —*Hist. Plant.* iv. 4.

Description.—*A. Maurorum* is a low shrub, armed with copious subpatent hard pungent spines, ½ to 1 inch long ; leaves simple, drooping from the base of the spines or branches, oblong obtuse, rigidly coriaceous, glabrous; flowers 1 to 6, from a spine or on short pedicels; calyx glabrous, $\frac{1}{12}$ to $\frac{1}{8}$ inch; corolla reddish, three times the length of the calyx; pod, 1 inch long or less, falcate or straight, constricted between the seeds; seeds kidney-shaped, greenish grey, very hard.

Taranjabín occurs in white grains or small agglutinated masses, mixed more or less with the thorns, pods, and leaves of the plant; it has hardly any odour; the taste is saccharine and afterwards slightly acrid.

Chemical composition—According to Villiers (*Compt. Rend.*, lxxxiv., 35), Alhagi manna after being boiled with animal charcoal, and evaporated to a syrup crystallized after some months in small brilliant crystals, which on crystallization from alcohol formed large white crystals of the formula $C^{12}H^{22}O^{11}+H^{2}O$. It is dextro-rotatory, its power being $+94^{\circ}48'$, or for the sodium flame, $+88^{\circ}\ 51'$. On boiling with an acid, it is converted into glucose, and its rotatory power is reduced to that of glucose, *viz.*, +53. It then reduces Fehling's solution; nitric acid oxidizes it to mucic and oxalic acids. Its melting point is 140°. It is thus seen to be identical with Berthelot's melezitose. It crystallizes in monoclinic (clinorhombic) prisms. The mannite of Alhagi also contains cane sugar, which may be isolated by treating the mother liquor of the melezitose with alcohol, and adding ether till a slight precipitate is formed. Crystals of cane sugar are then deposited. The mother liquor acts like a solution of cane sugar containing dextro-rotatory foreign substances which are not fermentable with beer-yeast. (*Journ. Chem. Soc. April*, 1877.)

Commerce.—The plant is collected in India. The manna is imported from Persia in skins and bags. Value, about 10 annas a pound.

FLEMINGIA GRAHAMIANA, *W & A.*

Hab.— Nilgiris, S. Koncan, Canara. The glands from the pods.

Vernacular.—Wars (*Arab.*).

History and Collection.—The plant yielding these glands is a small under-shrub. Mr. Lawson, the Government botanist in Madras, who has studied the genus Flemingia, concludes that it is not specifically distinct from *F. rhodocarpa*, Baker. The fact that the plant grows in Arabia and is the source of the substance known as Wars, which first attracted attention in Europe in 1867, remained unknown until 1884, when specimens were sent home by the British Resident at Aden. On the northerly slopes of the Nilgiri plateau, the fruits ripen in November, towards the close of the north-east monsoon, when they are covered with the peculiar garnet-coloured glands. The drug is collected by cutting off the clusters of pods from the ends of the branches and laying them in the sun to dry for one or two days. They are placed upon boards or paper, as during the process of drying much of the powder falls, and would be lost unless such a precaution were taken. The pods are then pressed or rubbed together by hand over sieves. The powder is mixed with hairs, stones and pieces of stalk; it is readily removed from these impurities by finally passing it through a fine muslin or lawn sieve. Although the plant occurs pretty frequently in Southern India, very little seems to be known by the natives of its colouring or medicinal properties, and from enquiries made of Canarese traders north of the Nilgiris and Tamil people to the south, no information could be gleaned of its glands being a marketable article; but at a recent Exhibition of the Agri-Horticultural Society at Madras, some of the powder was shown by a native dyer.

Characters and Tests.—Wars is a granular, mobile powder of a deep purplish-red colour, and without any marked odour or taste. Under the microscope it is in the form of cylindrical or subconical grains with oblong resin-cells arranged in stories in the interior. The powder ignites like lycopodium when thrown into the flame of a lamp. The specific gravity is 1·37. It is insoluble in cold water; when mixed together it at first floats on the surface, and if left in contact, it slowly becomes wetted and sinks. If, however, it is rubbed up in a mortar before being added to the water, or if it is boiled in it, the

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glands become broken and a bright yellow emulsion is formed; if this emulsion is allowed to stand, the resinous matter will subside and leave a yellow sweetish solution. The greater portion of Wars is dissolved by ether and warm alcohol, the resulting solution being of a bright orange-red colour; when treated with caustic alkalies the solution is intensely red. It sinks in oil of turpentine, imparting a slight colour to it after a time. When rubbed up in a mortar with water and the mixture submitted to distillation, an odour between that of caraway and lemon was observed in the distillate, and a greasy film in the receiver indicated traces of volatile oil as its source. Heated in a crucible, it at first blackened, giving off aromatic vapours, then intumesced and evolved inflammable gases which burnt with a smoky flame; when the charred mass was destroyed by prolonged ignition, a residue was left of a gray-coloured ash consisting mainly of finely divided sand.

Chemical composition.—The resinous colouring matter which constitutes the chief part of Wars has a brittle consistence when observed in thin strata. It is soluble in ether, alcohol, benzol, chloroform, carbon disulphide, acetic acid, and in solutions of potash, soda, ammonia, and their carbonates. It forms soluble compounds with lime and magnesia. It is precipitated from its solutions in the alkalies by acids in an apparently unaltered condition. Sulphuric acid dissolves it in the cold. Heated with nitric acid it rapidly oxidizes, yielding yellow-coloured products and a resin soluble in alcohol. A solution in spirit is partially precipitated by acetate of lead. Diluted alcohol appears to separate it into two resins; a soluble one of a yellow colour, and an insoluble one of a deep red. Heated with potash or soda an odour of citron is evolved. An ethereal solution of the resin allowed to evaporate spontaneously deposits a mass of crystals. The crystals are of a lighter colour than that of the surrounding red resin; examined microscopically, they appear as crops of acicular prisms radiating from a common centre. Ether and other liquids were added with a view to remove the crystals from the resin or *vice versa*; but all the volatile solvents tried resulted in forming a

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solution of both, and this rendered the separation an insuperable difficulty.

Wars and Kamala compared:—

	Wars.	Kamala.
Resinous colouring matter	72·83	78·19
Albuminous matter, &c	8·20	7·34
Cellulose	9·50	7·14
Water	3·44	3·49
Ash (principally sand)	6·03	3·84
Volatile oil	trace	trace
	100·00	100·00

As a dye the colouring matter of Wars is less in quantity and inferior in quality to that of Kamala. Medicinally, it is used by the Arabs to cure scaly eruptions of the skin. (*See Kamala.*)

FLEMINGIA TUBEROSA, *Dalz.*

Hab.—The Concan.

Vernacular.—Birmova (*Mar*).

History, Uses, &c.—A small trailing herb common in grassy places after the rainy season; it has trifoliate leaves studded with minute golden glands, and bears small purple pea-like flowers; the pods contain a single black seed which is almost round. The tuberous roots are eaten by the country people either raw or roasted, and are considered useful as a remedy for dysentery and leucorrhœa. As a remedy for the latter affection, the native Christian women stew them in wine or country liquor, but they appear to be equally, if not more, efficient when taken raw. At the country fairs and markets the tubers are often offered for sale at the end of the rainy season, in small baskets containing a pound or so each.

Description.—The tubers are ovoid-oblong, tapering to a point at the lower end, from two to two and a half inches in length; the outer skin is of a dark-brown colour and is easily removed by friction, exposing a smooth white surface. When

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injured the tubers exude a sticky juice, which on hardening becomes red and translucent. The taste is sweet and astringent. When roasted or boiled, the tubers lose much of their astringency, and taste like roasted chestnuts.

Chemical composition—

Yellow resin soluble in ether	1·64
Sugar and gum	25·47
Asparagin	4·13
Albuminoids	13·04
Tannin	trace.
Starch	40·12
Cellulose	12·16
Ash	3·44
	100·00

The yellow pigmental resin gave a blood-red colour with sulphuric acid, dissolved with red solution in alkalies, and was reprecipitated in yellow flocks by acids and green with ferric chloride. The dried tubers afforded 2·47 per cent. of nitrogen.

PUERARIA TUBEROSA, *DC.*

Fig.—*Wight Ic. t.* 412.

Hab.—Western Himalaya, tropical zone. W. Peninsula, Orissa.

Vernacular.—Sural, Siali (*Hind.*), Dári, Gúmodi (*Tel.*), Debrelara (*Paharia*).

History, Uses, &c.—Roxburgh remarks that the root is an immense tuber, with acrid properties, and that it is used as a cataplasm to reduce swellings of the joints. O'Shaughnessy says that it is a native of the Punjab, and Cleghorn states that the tubers are exported to the plains. It may possibly be the Shurava of Sanskrit writers.

Description.—The tubers of *P. tuberosa* vary in size and shape; they are pyriform or spindle-shaped, ranging in size from a small pear to a large turnip; they are developed upon the roots of the plant, and are composed of the woody layers of the root spread out and separated by a large addition of soft cellular tissue. The external surface of the tuber is brown and scurfy from exfoliation of the tuberous coat. The cut surface is white and spongy, and shows several concentric rings of woody fibres, and numerous well-marked medullary rays. The taste is somewhat acrid, slightly bitter, and very mucilaginous. The colour is not affected by ferric chloride or solution of iodine.

The following description of the plant is given in the *Flora of British India* :—"Stems shrubby, the branches finely grey downy. Stipules minute, deciduous, cordate-ovate; leaflets membranous, roundish, ½ to 1 ft. long, green, glabrescent above, densely clothed with whitish adpressed hairs beneath; flowers in dense, virgate, leafless, often panicled racemes, reaching 6 to 9 inches long; pedicels very densely fascicled ; calyx ⅙ to ¼ in. long, densely silky ; corolla short, blue, not quite twice the calyx ; limb of standard orbicular, distinctly spurred ; pod 2 to 3 inches long, membranous, flat, 3 to 6-seeded, clothed with long grey silky bristly hairs."

Chemical composition.—The peeled tubers in slices, dried by exposure to hot air, and reduced to powder, lost 5·21 per cent. of moisture at 100° C. The ash amounted to 18·01 per cent. No trace of manganese could be detected in the ash.

By exhaustion with 98 per cent. alcohol, a slightly yellowish tincture was obtained, which dried to a brittle mass easily reducible to a whitish powder, possessing a bitter-sweet taste, and partly soluble in boiling water with acid reaction. The resulting aqueous solution was neutralized, and agitated with chloroform-ether, but no evidence of an alkaloidal principle was yielded. The aqueous solution was then acidified and agitated with ether, when a trace of a resin was dissolved. The still acid aqueous solution, after driving off the dissolved ether, was agitated with amylic alcohol. A deep yellowish-brown extract was obtained, easily soluble in alcohol, and which darkened during evaporation. In cold water this extract was only slightly soluble, with a somewhat bitter taste. It was

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soluble in alkalies, and yielded a whitish-yellow precipitate on the addition of acids.

The original aqueous solution was again rendered alkaline and re-agitated with amylic alcohol. A small amount of a slightly bitter yellowish extract was yielded, which failed to afford any alkaloidal reactions, but reduced an alkaline copper solution after previous boiling with a dilute acid.

In another experiment the powdered tubers were percolated with amylic alcohol, and the percolate agitated with cold water; a colourless aqueous solution was obtained, which darkened during evaporation, leaving a yellowish residue. On the addition of cold water to this extract a portion dissolved, while the remainder swelled up into a soft mass similar in appearance to recently precipitated partly dried aluminum hydrate. On heating with water this dissolved, and on concentration, white warty masses separated, which under the microscope were seen to be destitute of crystalline structure. This principle is probably allied to inulin, but as far as we are aware no observation has hitherto been recorded on the solubility of inulin in amylic alcohol.

The fresh tubers afforded no reaction for starch. Saccharine matter was present which reduced Fehling's solution. A bitter principle, an easily oxidizable resin, and a resin acid were also present in addition to the principle which we have mentioned as being probably allied to inulin.

URARIA LAGOPOIDES, *DC.*

Fig.—*Burm. Fl. Ind.* 68, t. 53, f. 2.

Hab.—Nipal and Bengal to Ava.

Vernacular.—Pithvan (*Hind.*), Chákulia (*Beng.*), Davala (*Mar.*).

History and Uses, &c.—This plant is of interest as forming one of the ingredients of the Dasamula already mentioned (see *Tribulus terrestris*). On this account it is much used in Hindu medicine, but seldom alone. It is supposed to have alterative, tonic, and anti-catarrhal properties. The Sanskrit name, Prisniparni, signifies "spotted leaf." In Vedic times the plant was invoked as a goddess. According to Susruta it was given to women in the seventh month of their pregnancy with milk to prevent abortion. The Atharva-veda informs us that Prisniparni kills the monster Kanva, who wants to eat the germ. Another Sanskrit name is Atiguha, which signifies "great mystery."

Description.—Stems densely cœspitose, woody, slender, pubescent; petiole ½ to 1 inch; leaflets many, of both kinds, obtuse, broadly rounded at the base, 1 to 2 inches long, glabrous above, finely downy below; heads always simple, very dense, 1 to 2, rarely 3 inches long, under 1 inch thick, bracts subpersistent, distinctly ciliated; pedicels densely crinite, not longer than calyx; calyx 1-6th to 1-5th of an inch, lower teeth setaceous, densely plumose, corolla scarcely exserted; joints 1 to 2, brown, polished, finely pubescent. (*Flora of British India*.)

The medicinal properties attributed to this plant appear to be entirely fanciful.

Uraria picta, *Desv.*, *Jacq. Ic.*, t. 567. *Vern.*—Dábra (*Hind.*), Sankar-jata (*Beng.*), Prisniparni (*Mar.*), Pilavan (*Guz.*) is supposed by the Hindus to be an antidote to the poison of the Phúrsa snake (*Echis carinata*); it grows along the shady banks of water-courses, and blossoms towards the end of the rains. The stem is erect, shrubby and branched, 3 to 4 feet; leaves alternate, petioled, from simple to pinnate; leaflets, the lower or single, are generally oblong-ovate, two to three inches long, and one and a half broad, the leaflets of the compound leaves are linear lanceolate, all are obtuse, entire, and beautifully clouded on the upper surface, below a little reticulated and downy; racemes terminal, erect, rigid, cylindric, hairy, bracts of the peduncles chaffy, permanent; those of the flowers lanceolate, two flowered, falling; flowers numerous, small, red; pedicels incurved after the flowering time; calyx, apices of the divisions incurved and bearded, legume white and shining, consisting of from three to six oval joints connected by a slender isthmus, the incurved form of the pedicels presses them so much against the rachis that the form is with difficulty observed; seed kidney-shaped, 1-12th of an inch long, dull yellow. The medicinal properties attributed to this plant also appear to be entirely fanciful.

DESMODIUM GANGETICUM, *DC.*

Fig.—*Wight Ic., t.* 271.

Hab.—The Himalayas to Pegu and Ceylon.

Vernacular.—Sárivan (*Hind.*), Sálvan (*Guz.*), Daye, Salparni (*Mar.*).

History, Uses, &c.—This plant is of interest as being an ingredient of the Dasamula Kvatha so often mentioned in Sanskrit works; it is considered to be febrifuge and anti-catarrhal. In the Dasamula it is placed among the five minor plants (see *Tribulus terrestris*), a decoction of these is directed to be used in catarrhal fever, cough and other diseases supposed to be caused by deranged phlegm. The five major plants are prescribed in fever and other diseases supposed to be caused by deranged air. The ten together are used in remittent fever, puerperal fever, inflammatory affections within the chest, affections of the brain, and many other diseases supposed to be caused by derangement of all the humours. (For further information upon these points, consult Chakradatta.) The Sanskrit name is Shálaparni, "having leaves like the Shál" (*Shorea robusta*). In the Nighantás the root is described as alterative and tonic, and a remedy for vomiting, fever, asthma and dysentery.

Description.—Stems sub-erect, reaching 3 to 4 feet high, woody, slightly angular, clothed with short grey down upwards, leaflet oblong, usually 3 to 6 inches long, not more than ½ to ⅙ inch broad, rounded at the base, narrowed gradually to an acute point, thinly clothed beneath with adpressed gray hairs, not

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reticulate-venose; petiole $\frac{1}{2}$ to 1 inch; racemes copious, ascending, lateral and terminal, the latter sublax, 6 to 12 inch long, simple or with a few short ascending branches in the lower part; pedicels $\frac{1}{12}$ to $\frac{1}{4}$ inch, ascending; bracts minute, setaceous; calyx under $\frac{1}{12}$ inch, finely downy; teeth lanceolate; corolla $\frac{1}{8}$ to $\frac{1}{6}$ inch; pod falcate, $\frac{1}{2}$ to $\frac{3}{4}$ inch long, $\frac{1}{12}$ to $\frac{1}{8}$ inch broad, 6 to 8 jointed, glabrescent, or clothed with minute hooked hairs. (*Flora of British India.*)

The roots have a soft thick bark and a central woody column; no tannin is present.

Chemical composition.—The roots reduced to fine powder yielded:—

Water at 100°C	10·43	per	cent.
Ash	6·20	,,	,,
Petroleum ether extract	·62	,,	,,
Ether extract	·47	,,	,,
Alcoholic ,,	1·07	,,	,,
Aqueous ,,	8·76	,,	,,

The ash contained a trace of manganese. The petroleum ether extract was yellowish green, oily, and deposited fine needles on standing: it was partly soluble in alcohol with acid reaction: the insoluble residue was white; no alkaloidal principle was detected.

The ether extract was yellowish, had an aromatic odour, and contained a trace of oil and resin: it was only partly soluble in caustic alkalies, with a deep yellow coloration: no alkaloidal principle was present.

The alcoholic extract contained a principle which gave a marked reaction with alkaloidal re-agents: and a yellow resin soluble in alkalies and reprecipitated by acids. No reaction with ferric chloride. The aqueous extract reduced Fehling's solution; on boiling it gave no precipitate with dilute acids, with ferrocyanide of potassium and acetic acid a very faint turbidity was produced: mixed with an equal volume of absolute alcohol a very slight turbidity was occasioned: plumbic acetate and hydro-acetate both gave a white precipitate.

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Ormocarpum sennoides, *DC.*, *Wight Ic. t.* 297, is a low shrub of the Western Peninsula and Ceylon, with terete slender branches. The young shoots and flowering parts are covered with a soft glutinous hair; the glutinous secretion is of a golden yellow colour. The leaves are pinnate, leaflets 9 to 17, alternate, oblong-obtuse, membranous. The racemes are short and axillary, 3 to 6 flowered, flowers yellow. Pods 2 to 5-jointed, pendulous, much contracted at the joints, muricated, glutinous. The plant is called Kát-morungi in Tamil, Kadunugge in Canarese, and Adavimúnaga in Telugu; a decoction of the root is used in fever as a tonic and stimulant, and a liniment (*taila*) in paralysis and lumbago.

Desmodium triflorum, *DC.*, *Vern.* Sirupullady (*Tam.*), Moonoodoo-moordoo (*Tel.*), Kadalaya (*Hind.*), Koolaliya (*Beng.*), Rán-methi (*Mar.*), is very common in sandy ground under the shade of trees. The leaves are used as a galactagogue by native females after confinement; they are well washed and ground with cow's milk, and taken daily in the morning. They are also administered to children as a remedy for diarrhœa caused by indigestion, and in convulsions. (*P. S. Mootooswamy.*) Roxburgh remarks that the natives apply the fresh plant, well bruised, to wounds that do not readily heal.

ABRUS PRECATORIUS, *Linn.*

Fig.—*Rheede, Hort. Mal. viii.* t. 39; *Bentl. and Trim.*, t. 77. Jamaica Wild Liquorice, Jequirity (*Eng.*), Arbre a chapelets (*Fr.*).

Hab.—India and other hot countries. The seeds, root and leaves.

Vernacular.—Gunj, Ghungachi (*Hind.*, *Beng.*), Gunjha (*Mar.*), Gundumani (*Tam.*), Chanoti (*Guz.*), Guri-ginja (*Tel.*), Gulganji (*Can.*).

History, Uses, &c.—This plant is mentioned by Susruta and the older Sanskrit writers, it must therefore have long been in use as a medicine among the Hindus; they describe two

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varieties, namely, red and white-seeded. The seeds are said to be poisonous, and are used internally in affections of the nervous system, and externally in skin diseases, ulcers, and as an application to fistulas to excite inflammatory action. The root is described as emetic. Examples of compound medicines containing the seeds, extracted from Sárangadhara, Chakradatta, and the Bhavaprakasa will be found in Dutt's Hindu Materia Medica, p. 152. Mahometan writers under the name of Ain-ed-dik (cock's eye) describe the seeds, and state that they are hot and dry, tonic and aphrodisiac. Their use by goldsmiths as a weight is alluded to in the following well known Doha (couplet) :—

> Soná kahe sunár se, "uttum mhári ját
> Kále munh ki ghungchi, aur tule hamáre sáth."

My rank is of the highest, said the gold to the goldsmith, shall I be weighed against that black-faced seed! Sloane, in 1700, appears to have been the first to suggest the use of Abrus root as a substitute for liquorice. Prosper Alpinus, who visited Egypt in 1592, only mentions the use of the seeds as beads, and states that they are sometimes eaten, but are very unwholesome; he calls the plant "abrus," a name probably of Coptic origin, but possibly derived from the Greek αβρος, pretty. Greek and Latin writers do not mention any plant bearing this name. Dr. Burton Brown (*Punjab Poisons*) records a case in which 40 seeds of Abrus, administered internally, caused purging and vomiting, with symptoms of collapse and suppression of urine; the patient recovered under the use of stimulants.

In the Concan singers chew the leaves of the white-seeded variety as a remedy for hoarseness; they are also chewed with cubebs and sugar to cure aphthæ of the mouth. In spermatorrhœa with bloody discharges, equal parts of the juice of white Abrus leaves and Henna leaves are rubbed with the root of *Holostemma Rheedii*, cummin, and sugar, and administered. Abrus seeds are said to have been used for centuries in Brazil as a popular remedy for granular lids and pannus, and attention was called to this practice in Europe in 1862, without apparently leading to any experiments with the drug. Ainslie says:—

"This root, when dried, coincides so exactly with the liquorice root of the shops, that it is often sold for it in the bazaars in Bengal." Other writers repeat the same statement, one which we cannot confirm, as we consider the root to bear very little resemblance to liquorice either as regards appearance or qualities; as pointed out by Mr. Moidín Sheriff, the leaves are by far the sweetest part of the plant, and from them a tolerable extract may be made, but in most parts of India, where true liquorice is obtainable in any quantity as an article of commerce, it would be much more expensive to collect them than to use liquorice.

Description.— Leaves 2 to 3 inches long, abruptly pinnated, leaflets 8 to 20 pair, linear oval, obtuse at both ends, glabrous or slightly hairy, membranous, deciduous, $\frac{3}{8}$ to $\frac{5}{8}$ of an inch long, and $\frac{1}{6}$ to $\frac{1}{5}$ of an inch broad, taste sweet and like that of liquorice. Seeds bright scarlet, with a black spot at one end; white, polished, smaller than a pea; average weight, scarlet variety 1·75, black 1·77, and white 1·97 grains. Root long, woody, hard, and much branched, seldom more than $\frac{1}{4}$ inch in diameter. Cortical layer very thin, reddish-brown; wood yellowish white; odour and taste acrid, hardly at all sweet.

Microscopic structure.—Within the middle zone of the bark is a layer of sclerenchymatous tissue. Liber fibres are scattered through the interior of the cortical tissue, but do not form wedge-shaped rays as in liquorice.

The seeds have been examined by Dr. D. D. Cunningham of Calcutta. (*Ind. Med. Gaz.,* 1882.) Proceeding from without inwards he found—1*st*, a single layer of thick-walled, columnar cells containing colouring matter, each cell dilated peripherally, and in many cases having a slight basal bulbosity. The peripheral dilated portion was observed to be cut up into a number of more or less cuneate portions; 2*nd*, a thick stratum of small cells, with thick walls and irregular sinuous outlines; 3*rd*, a thick stratum of large thin-walled cells; 4*th*, a thin stratum of small also thin-walled cells; 5*th*, a stratum of elongated thin-walled cells; 6*th*, a stratum of thickened cells, two or three layers deep; *7th*, a single row of minute thin-walled cells of more or less cubical contour; *8th*, a stratum of thick walled cells with dense yellowish, granular contents; *9th*, a stratum of thickened, more or less parenchymatous cells, with mere traces of cavities or contents. The cotyledons are composed of large thick-walled cells containing granular matter and oil globules. The central cavities of the cells communicate by a system of processes which pass through the cell wall and are met by similar processes from the neighbouring cells.

Chemical composition and Physiological action.*—The seeds of jequirity contain a substance which, as is well known, when extracted, as in a watery infusion, produces a local irritation and inflammation of the conjunctiva, which has been utilized in practical medicine for the cure of granular lids and of pannus. Its employment in these conditions has not, however, been found to be so beneficial as at one time was thought probable, so that at the present time jequirity may be said to possess chiefly a scientific interest—one, as I shall indicate, of possibly great significance. Investigations into the exact nature of the poison have not been wanting, and the knowledge obtained from them has gone through many curious phases.

From the researches of Sattler, Cornil, and Berlioz, it was concluded that the irritant action of jequirity was due to a special bacillus which grew in the infusion of the seeds, and was called the jequirity bacillus. Contrary, however, to the behaviour of liquids containing specific bacteria, the physiological activity of the infusion of abrus seed was totally destroyed by heating it to the boiling point of water (Klein); and, following this result, Warden and Waddell† separated from the seed a body they called "abrin," which was a proteid body, and which possessed the physiological properties of jequirity. Furthermore, although these observers found bacteria in the local lesions produced by jequirity, these organisms were of various kinds,

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* From a report by Dr. Sidney Martin, presented to the Scientific Grants Committee of the British Medical Association, *Brit. Med. Journal*, July 27.

† "The Non-Bacillar Nature of Abrus Poison," Calcutta, 1884.

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and, after cultivation and separation, were found to have none of the poisonous properties of jequirity. To dispose at once of this idea of the bacterial nature of jequirity poison, I may say that in my experiments, using a pure product, I have found no bacteria present in the local lesions, either in those produced at the seat of injection or in those produced internally in the peritoneum or alimentary canal. The sections were stained by Gram's method.

We must look, therefore, to the proteid or proteids present in the seed for the poison of jequirity. Warden and Waddell's 'abrin" as described by them, did not possess very definite characteristics; it was called a vegetable "albumin," but evidently did not belong to this class, as it was precipitated by acetic acid. In 1886, I separated and examined the proteids present in the seeds, and obtained the following results*—both of the proteids separated possessing poisonous properties.

Nature of Jequirity Poison.—The seeds contain two proteids—a globulin and an albumose. The globulin is soluble in 15 per cent. sodium chloride solution, and coagulates by heat between 75° and 80° C. Like other members of its class, it is precipitated from solution by saturation with sodium chloride and magnesium sulphate. It belongs to what I have described elsewhere as the vegetable paraglobulins.† The albumose is soluble in water, is not precipitated by boiling, but is thrown down by nitric acid, the precipitate being soluble on heating the solution and coming down again on subsequent cooling, this being the characteristic reaction of the albumose class. This body also gives the "peptone" reaction, namely, a pink coloration with copper sulphate and caustic potash.

For the investigation of the physiological action of these two proteids, the mode of separation from the seed is important, because, as I shall discuss subsequently, it is a question whether these proteids are of themselves poisonous, or produce their toxic effects by having a non-proteid body, as it were, tacked on to them—in fact a body, possibly alkaloidal in nature, not completely separated from the proteid in the preparation of the pure poison.

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* *Proc. Roy. Soc.*, vol. 42, p. 331.

† *Proc. Physiolog. Soc.*, 1887.

The globulin is separated by extracting the crushed and decorticated seed with 15 per cent. sodium chloride solution, and precipitating the clear filtrate by saturation with solid sodium chloride after acidulating with acetic acid. The precipitate of globulin with part of the albumose is mixed with distilled water, and dialysed in running water for several days. The globulin is in great part thrown down in the dialyser, while the albumose remains in solution. The globulin is now removed by filtration, and washed with distilled water (previously boiled to sterilise it) for two days, in order to remove any albumose or sodium chloride clinging to the precipitate, the absence of the albumose being tested by the washings giving no reactions for a soluble proteid, and the absence of the salt by a negative reaction with silver nitrate. The globulin is then removed from the filter and dried over sulphuric acid. Prepared in this way, it is a whitish-yellow, amorphous powder, soluble for the most part in 15 per cent. sodium chloride, and giving the reactions previously described. In the dried state, it may be kept for a long time without losing its physiological properties. Specimens prepared for more than fifteen months are as active now as when first dried. This fact is, indeed, only in accordance with the behaviour of other dried proteids; they can be kept an indefinite time in the dried state without undergoing any chemical change.

The albumose was prepared by making a concentrated watery extract of the seeds, and filtering the clear infusion direct into an excess of absolute alcohol, thus throwing down both proteids as a white precipitate. After a few days the precipitate was removed, redissolved in water, and reprecipitated by alcohol, this process being repeated at intervals of a few months. The precipitate was allowed to stand under alcohol for about eight months or longer, at the end of which time the globulin was completely coagulated, while the albumose was still soluble in water. Dried over sulphuric acid,

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the residue was a yellowish-brown, amorphous powder, consisting of coagulated globulin and unaltered albumose.

*Physiological Action of the Proteids of Jequirity.**—For subcutaneous injection and for instilling into the eye a solution of the proteids was made. The globulin was dissolved in 15 per cent. sodium chloride solution, and the albumose in distilled water or normal saline solution (0·75 per cent. NaCl). Previous to using these liquids or solvents, they were well boiled to sterilise them, and then cooled. A weighed quantity of the proteid was then dissolved and used in the experiment; or a solution of the proteid was made, and the quantity present was estimated.

Local Action on the Eye.—A watery infusion of the seeds when instilled into the eye produces, as is well known, severe inflammation with purulent discharge; and it is this action which is both beneficial in the treatment of granular lids and of pannus. Both the globulin and the albumose of jequirity possess this property. Thus in one experiment 2 milligrams of the solid globulin (containing some coagulated proteid) were placed on the inner surface of the left eyelid of a large rabbit. In seventeen hours and three-quarters the conjunctiva was reddened and slightly swollen; there was no chemosis, but there was a clear serous discharge. In twenty-four hours, there was intense purulent ophthalmia, with subconjunctival ecchymosis: the cornea being quite clear. The purulent discharge lasted till the death of the animal, eighty-three hours after inoculation; the animal being apparently ill for about four hours before death. At the *post-mortem*, there was severe subconjunctival hæmorrhage, with œdema round the eyeball. If the dose be smaller, the animal does not die after eye inoculation, nor does it suffer from any general symptom; but local inflammation and œdema with purulent discharge always follow in about sixteen or seventeen hours.

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* The action of the globulin was investigated in co-operation with Dr. Wolfenden; for the account of the albumose I alone am responsible. The results are published in two papers in *Proc. Roy. Soc.*, May 1889.

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One milligram of the albumose dissolved in two minims of sterilised distilled water, when placed on the eye of a rabbit produced in less than twenty-four hours severe conjunctivitis with chemosis, and left at the end of six days a steamy cornea with leucomata and subconjunctival ecchymosis. The animal showed no symptoms of poisoning. Both globulin and albumose therefore possess this property of producing severe conjunctivitis.

General Action on the Body.—The symptoms produced by the subcutaneous injections of the proteids of jequirity are those which have been described by Drs. Warden and Waddell. The action of the globulin is not, however, quite identical with that of the albumose. In the first place, the globulin is more poisonous than the albumose. In rats, for example, 10 milligrams of globulin per kilo of body-weight is a fatal dose, and in the same animals, 60 milligrams of albumose per kilo of body-weight.

If the above mentioned dose of globulin be injected into a rat, symptoms of poisoning begin to appear in about six hours; the animal them seems a little languid, and in a condition impossible to distinguish from sleepiness. It continues in this state, making no voluntary movement, irresponsive to slight external stimuli, and with half shut eyes. It lies huddled up in its cage, the breathing becomes more rapid, and bloody motions are passed shortly before death, which occurs in about twenty-four hours after inoculation. If the animal is with young, it aborts. *Post-mortem*, there are signs of œdema and punctiform ecchymosis at the seat of injection, and punctiform ecchymosis also beneath the peritoneum, and sometimes in the lungs. The intestines are congested, and sometimes greatly inflamed; the adenoid patches in the mucous membrane are swollen, and submucous ecchymoses are often seen. The blood sometimes remains fluid for a long time, and is sometimes coagulated. The symptoms of poisoning by the albumose and the *post-mortem* signs are similar to those described as produced by the globulin.

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It may be pointed out that there are no symptoms referable to definite lesions of the organs, except the occurrence of bloody motions due to gastro-enteritis. The sleepiness, in gradually increasing coma, may be explained by an effect on the cerebrum; as there is not sufficient dilatation of the vessels of the abdominal organs to explain the occurrence of coma by drainage into the "splanchnic area," the occurrence of rapid breathing, which is produced chiefly by the globulin, may be explained by an affection of the respiratory centre. The only early symptom of abrus poisoning is a fall of body temperature, and this is produced both by the globulin and the albumose.

This lowering effect of the jequirity proteids on body temperature was noticed in cats by Warden and Waddell. It is important, when taken in consideration with the fact that rattlesnake venom produces a similar effect (Weir-Mitchell and Reichert), and that, on the other hand, animal albumoses and peptones have been shown by Ott and Colmar* to produce fever in mammals.

Effect of Heat on the Activity of Jequirity Proteids.—Boiling the liquid destroys the activity of the infusion of jequirity seeds. This, as has been mentioned, is an argument against the bacterial nature of the poison. It was desirable to test, however, with exactness at what temperature this activity was permanently destroyed. For this purpose solutions of the globulin and albumose were momentarily heated up to 50°, 60°, 75°, 80°, 85°, C. before being used for inoculation. In each separate series of experiments an unheated solution of proteid was also inoculated, in order to have a control, and a lethal dose was always used. For the details of these experiments the papers in the *Proceedings of the Royal Society*, already quoted, must be referred to. Suffice it to say here that the results obtained were—(1) that the activity of the globulin was permanently destroyed by momentarily heating its solution to between 75° and 80° C., that is, about its coagulation temperature, while the solution of albumose had to be heated up to 85° C., before

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* *Journal of Physiology*, vol. viii., p. 218.

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the activity of the proteid was destroyed; (2) that momentary heating of the solution to above 50° C, but below 75° in the case of the globulin, and 85° in the case of the albumose, weakened the activity of the proteid without destroying it.

The conclusions therefore arrived at regarding the jequirity poison may be thus summarised:—

1. The toxic action of the jequirity (*Abrus precatorius*) resides in two proteids—a globulin and an albumose.

2. Both these proteids produce nearly the same effects, namely, local œdema and ecchymosis at the seat of inoculation, with ecchymosis in the serous membranes, and gastro-enteritis, the blood in many cases remaining fluid. The general symptoms are a gradual sleepiness, ending in coma, with rapid onset of rigor mortis.

3. That both portions have a remarkable lowering effect on the body temperature; the globulin, at the same time, producing rapidity of breathing, while the albumose does not have this effect to the same degree.

4. That the activity of both proteids is destroyed by a temperature below the boiling point of water; the globulin between 75° and 80° C. and the albumose at 85° C., while temperatures below these points but above 50° C. diminish the poisonous activity.

Relation of the Abrus Poison to Snake Venom.—It is chiefly due to the researches of Weir-Mitchell that the poisonous principles of snake venom have been shown to be of an albuminoid nature. In the latest publication on the subject Weir-Mitchell and Reichert* affirm as the result of their analyses and experiments that the poisonous proteids present are of two kinds—a globulin and a peptone, or peptone-like body; that all kinds of venom contain these two bodies, although in varying proportions, speaking generally, the globulin being greater in proportion to the "peptone" in viperine snakes (such as the rattlesnake), and the peptone being in greater proportion in the colubrine snakes, such as the cobra; that both the globulin and peptone of the venom are poisonous, producing practically the same general symptoms, but with this exception (and a noticeable one it is), that the great local ecchymosis and inflammation of snake-bite is due to the globulin present in the venom and not to the "peptone."

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*"Researches upon the Venom of Poisonous Serpents," Philadelphia, 1885.

For reasons which I have detailed elsewhere,* it seems to me that Weir-Mitchell and Reichert's venom "peptone" is not a true peptone, but belongs to the albumose class of proteid bodies. The relation of abrus poison to snake venom is now apparent. Abrus seed contains two poisonous proteids—a globulin and an albumose—which both produce local œdema and ecchymosis. Rattlesnake venom also contains a globulin and a peptone-like body (probably an albumose), the former of which produces local ecchymosis and inflammation. The resemblance is further strengthened by the fact that heat diminishes the activity of both abrus poison and of snake venom; but in this respect abrus poison seems to be more sensitive than venom. Thus, even after boiling and filtering, rattlesnake venom, if given in sufficient dose, is fatal; and cobra venom is still active (although permanently destroyed by boiling for half an hour) while, with abrus proteids, a momentary heating of the globulin in a solution up to 80° C., is sufficient to destroy its activity, while with the albumose the destroying temperature is 85° C. Rattlesnake venom, like abrus poison, also lessens the body temperature. The great difference, however, between snake venom and abrus poison rests in the fact that venom produces local paralysis and general convulsions, while abrus has no such effect. Abrus seems to affect the cerebral hemispheres, producing stupor, ending in coma.

It is evident, therefore, that while abrus poison bears some resemblance to snake venom it is far from being identical with it.

Nature of Abrus Poison.—At present it is not explicable why proteids should be poisonous; why, when injected subcutaneously or into the venous system, they should cause death. And so anomalous does the toxic power of these bodies seem that we are bound to consider whether a proteid is of itself poisonous or possesses toxic properties by virtue of some agent or body tacked on to it or formed from it. Such an agent associated with a proteid would be called a "ferment." We know that the ferments used in digestion are normally associated with proteids, although Cohnheim claimed that he had separated ptyalin from all associated proteid, and Brücke stated the same of pepsin; and even granting that these two ferments may be separated from their associated proteids the fact remains that ferments are in nature closely linked with albuminoid bodies. What characteristic of unorganized ferments, we may fairly ask, are present in abrus poisons which would lead to the supposition that what might be called a "toxic" ferment is present? The unorganized ferments known alter the constitution of the bodies on which they act, the digestive ferments acting on proteids, amyloids, and fats, while other ferments, such as the fibrine ferment and the curdling ferments, cause the proteids on which they act to assume a solid form. All these ferments have certain characteristics common to all; their action is increased by a moderate heat and permanently destroyed by boiling their solutions; and their activity is not apparently diminished after they have produced their effect.

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* *Proc. Roy. Soc.*, May, 1889.

From this it will be seen that the fact which would point to abrus poison being a "toxic" ferment is the fact that its activity is permanently destroyed by a moist heat below 100° C. Farther than this we cannot at present go. Abrus globulin and albumose possess neither a proteolytic nor amylolytic action, whatever the reaction of the digestive mixture may be. The fact that the activity of the globulin is destroyed at about its coagulation temperature would seem to point to an alteration in the constitution of proteid as the cause of the loss of poisonous activity; but this again is the temperature at which ferments are destroyed. No evident effect, chemical or physical, is noticed if the albumose be heated up to 85° C. or even boiled, yet its toxic activity is at once and for ever destroyed. This may point to a ferment associated with the albumose; but until we know the chemical constitution of the proteid molecule we cannot assert that this degree of heat does not so alter the construction as to prevent the development of the toxic action. In this uncertain condition the matter must at present rest. It may be considered that the toxic action is not due to the proteid nor to a ferment attached to it, but to some chemical toxic body carried down with the proteid in its preparation. The effect of heat on the toxic activity of abrus would seem at once to dispose of this view. Toxic bodies, such as ptomaines and leucomaines, formed from proteids, are not so sensitive to heat as the abrus poison; and if the details of the preparation of abrus globulin and albumose be referred to it will be seen that the prolonged dialysis in running water and the long extraction of the albumose by alcohol preclude the presence of any crystalline product in the residue obtained.

The concentrated aqueous infusion of abrus root has a dark brown colour, and a somewhat acrid taste accompanied by faint sweetness. When it is mixed with an alkaline solution of tartrate of copper, red cuprous oxide is deposited after a short time; hence we may infer that the root contains sugar. One drop of hydrochloric or other mineral acid mixed with the infusion produces a very abundant flocculent precipitate, which is soluble in alcohol. If the infusion is mixed with a very little acetic acid, an abundant precipitate is obtained, but is dissolved by an excess. This behaviour is similar to that of glycyrrhizin. The leaves contain a sweet principle similar to that of liquorice. (*Pharmacographia.*) Warden and Waddell have pointed out that the stems and roots of the Abrus plant possess toxic properties similar to the seeds. This fact is of importance when it is remembered that the roots are referred to in the *Pharmacopœia of India* as a substitute for liquorice.

Dr. Warden has succeeded in isolating an acid from the seeds, which he represents by the formula $C^{21} H^{24} N^{3} O^{4}$, and has named *abric acid.* He also obtained a small quantity of pungent volatile oil, but both these substances proved to be inert.

Toxicology.—The Cattle Plague Commission, in their report dated 1870, remarked that a large proportion of the criminal cases of cattle-poisoning are effected through the agency of Abrus seeds. In 1873, Dr. Center drew special attention to this fact; and more extended inquiry showed that this practice was common throughout the greater part of India. The Chamár or "Skinner" caste are the class who mostly practise this mode of poisoning, and although their object usually is to obtain a supply of hides, they have been known to use these seeds for the purpose of committing murder. These people prepare small spikes by soaking the seeds in water and pounding them; these are dried in the sun, oiled and sharpened upon a stone, so that when fixed loosely in a handle they can be driven beneath and left in the skin of an animal. They are called by the natives *sui* (needles) or *sutari* (awls). (*Conf. Ann. Repts. of the Chem. Examiners of Bengal and N.-W. Provinces from* 1874 *up to date.*)

Dr. Warden* says:—"The preparation of 'suis' is an operation which apparently requires some little skill; and the following particulars are from an article in the *Police Gazette* for December 1880, communicated, I believe, by an officer in the Police Department, who obtained his information from a Chamar prisoner in the Patna Jail, who prepared 'spikes' before him, with one of which a bullock was stabbed in the back of the neck, death ensuing on the second day. The shell of each seed is carefully broken and removed, and the seeds softened by soaking in water, and pounded on a stone in order to form a paste. The lump of paste is then rolled with the palm of the hand on the stone, until it is of a cylindrical shape, with a sharp point. The point, about ¾ of an inch long, is then cut off and forms the 'sui,' or 'sutari,' as it is termed in some districts, from its resemblance to the point of a cobbler's awl. After half-a-dozen or more 'sutaris' have been made, some straw is cut into lengths of about 2½ inches, and a 'sutari' inserted in each end; the straws are then put in the sun to dry, care being taken that the 'sutari' points are not injured. As soon as a 'sutari' is thoroughly dry and hard, the point is 'edged' on a brick, after which it is soaked in some animal fat for a night, and the instrument is ready. Occasionally the point of the 'sutari' is slightly curved. Suis weigh on an average 1½ to 2 grains, and vary in colour from dirty white to dark brown or nearly black. A handle of wood is then made, about 3 to 3½ inches long, and like the handle of a bradawl. At the end of the handle, which is about an inch in diameter, two holes are drilled, about ¼ to ⅜ of an inch in depth, and about ¾ of an inch apart, and into each hole the thick end of a 'sutari' is pressed, a piece of cloth being first spread over the holes in order to afford a firmer hold. Bamboo wood is frequently used for a handle, a small cane being selected, and a portion cut off so as to include two joints: one joint has the holes drilled for receipt of the 'spikes,' while the other is sometimes removed, exposing the cavity of the bamboo, in which the spare 'sutaris' are kept wrapped in a rag. The blow given with the instrument is delivered with great force, so that the whole of the sutari protruding from the end of the handle is driven into the flesh; any attempt to withdraw the 'sutari' by pulling at the piece sticking out, invariably breaks it, a portion being left in the wound."

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* Notes on the seeds of the *Abrus precatorius.—Ind. Med. Gazett* 188 .

"In some cases *suis* are made with the milky juice of the *Calotropis gigantea* instead of with water, and the effect is then supposed to be more rapid. Metallic mercury, dhatura, aconite and arsenic are also occasionally added. When the subject of *sui* poisoning first engaged attention there was a suspicion that snake venom might possibly be the active agent, but this was shown to be incorrect."

"A few cases have been recorded in which 'sui' wounds have proved fatal in the human subject. In the Bengal Police Report for December 1880, the following note occurs: 'In 1871 a man was murdered by a sutari being driven into his side; lately another man was wounded by a sutari while asleep, and died from lock-jaw; a third man was wounded with a sutari, but escaped death by the affected part being excised. This man's cousin, however, died from the effects of a sutari being driven into his cheek. The offenders in these cases were suspected to be Chamars, who being poor and of low caste, can be induced to undertake such acts of assassination for small remuneration.' "

"Mr. W. Sutherland, Barrister-at-law, of Bankipore, has kindly furnished me with notes of one of the above cases, in which a man was killed by being stabbed in the cheek with a 'sutari': these notes throw an interesting light on the value in which human life is held in India, in districts in which civilization is supposed to be advanced. The case occurred at Bankipur, and two persons were implicated, a man and a woman; and the following is an abstract of the statement of the latter:—'I used to earn my living in Bankipur, at Sunt Aman Khan's. Aman Khan, his chella, turned me out, and would not give me sufficient food. I stole a seer of rice, and he abused and beat me. I was crying and lamenting over my ill-fate. Mugyra said, "Why are you crying?" I said "If some one killed him, it would be well." She said, "Call Suntokhi, and he will put you up to something." I then went Suntokhi Chamar's, and told him to get some medicine that would kill Aman Khan. He said he would go to Magha and bring some. After ten days he told me he had not been to Magha. Mugyra then told me to go to Dooly Chamar, who was a great poisoner, and had killed several persons. Dooly, on being spoken to, asked for 50 or 100 rupees. I therefore remained quiet. After ten days, Dooly came to my house and wanted 5 rupees and seven pieces of cloth of seven colours, and black pigeons and a black kid; I gave him one rupee and a half, the price of the things. The next morning he came to me for five rupees advance, saying he would destroy my children, if I did not pay it, by means of witchcraft. I paid him five rupees: after this he again threatened me, and I gave him ten rupees. When 8 or 10 days had passed he said he would do what I wanted, and on the night fixed, he smoked in my house, and then at midnight stabbed the wrong man.' Both prisoners were sentenced to transportation for life under sections 304 and $\frac{304}{109}$ of the Penal Code."

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"The wound inflicted in this case is described as penetrating about ¾ of an inch deep, and implicating the skin and muscles of the right cheek. After the injury, the wound appears to have been incised, and 'two small black hard substances' extracted. The patient was treated in the Government Dispensary, Bankipur, and died apparently, on the third day after the accident, from tetanus. In the autopsy report a cursory reference only is made to the wound; it is described as 'one penetrating wound, with some swelling on the right cheek.' The brain and its membranes, and the lungs, liver, spleen, and kidneys were congested. The coats of the stomach were congested, and some ecchymosed spots were visible on its internal surface. The intestines were healthy."

"Judging from the medical evidence, death appears to have been clearly due to traumatic tetanus; and there is no record of symptoms, such as have been observed after the insertion of a 'sui' into the tissues of one of the lower animals. No evidence was apparently adduced to prove that the 'two pieces of small black hard substances' extracted from the wound, were really fragments of a 'sutari' or poisonous. The part therefore played by the *poison* of the 'sutari' is very problematical: and a fatal result would probably have ensued had the man been stabbed with a *thorn*, instead of with a *sui*.

"Dr. Center* has recorded notes of a fatal case of sui poisoning, in which the cause of death appears to have been clearly traceable to the poisonous nature of the 'sutari.' A man when sleeping was awakened in the morning by two blows on the neck, and appears to have seen his assailant retreating. After he went out to his work, his mother found two substances, each a little larger than a barley-corn, on his bed. On his return at mid-day, he complained of pain in the neck, and his mother found two punctures, and out of one of these she picked a small black substance similar to those found on the bed. He was taken to Rawalpindi on a charpoy, arriving on the following morning, when he was immediately examined by Dr. Ince, who reports—'I found a swelling on the right side of the neck, in which were two small punctures, about two inches apart. He was then sensible, but suffering from severe pain in the neck; difficulty of swallowing and much fever. He was sent for treatment to the dispensary. The swelling and pain in the neck rapidly increased and erysipelas supervened. He died exactly three days after having been stabbed. On *port-mortem* examination there was much swelling of the neck, extending over the right side of the chest also, and the skin had a livid appearance. On cutting into the swelling, much blood was found, and the products of inflammation. This had extended to the right lung, which was also much inflamed, and adherent to the ribs by recent bands of lymph. The other organs were healthy, except the spleen, which was somewhat enlarged. The *three small black substances* mentioned were examined by Dr. Center, and recognized as part of such suis as are often sent in cases of cattle poisoning. Microscopically their characters were found to agree with those of rati seeds. Blood was found on one. On insertion below the skin of a dog, the animal died in 50 hours, and on *port-mortem* examination, diffuse inflammation, extending from the puncture along part of one side of the body was found."

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* Report, Chemical Examiner, Punjab, 1873.

The roots of **Taverniera nummularia**, *DC.*, and **Alysicarpus longifolius**, *W. & A.*, are sweet like liquorice, and are called *liquorice* by the Indian peasants.

MUCUNA PRURIENS, *DC.*

Fig.—*Wight Ic., t.* 280; *Bentl. and Trim., t.* 78. Cowhage (*Eng.*), Petit pois pouilleux (*Fr.*).

Hab.—From the Himalayas in the plains, to Ceylon and Burma.

Vernacular.—Kiwachh (*Hind.*), Kuhilí (*Mar.*), Punaik-kali (*Tam.*), Alkusi, Kámách (*Beng.*), Pilli-adugu, Dulagondi (*Tel.*), Nasaguni-gida, Turachi-gida (*Can.*), Kivánch (*Guz.*).

History, Uses, &c.—The plant has long been used medicinally by the Hindus; according to Susruta the seeds are

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aphrodisiac. The Bhavaprakasa gives the following directions for their administration:—"Take of Mucuna seeds 32 tolás, boil them in 4 seers of cow's milk till the latter becomes thick. The seeds should now be decorticated and pounded, fried in ghi (clarified butter), and made into a confection with double their weight of sugar. The mass should then be divided into balls and steeped in honey. Dose about a tolá (180 grs.)." This preparation is said to be powerfully aphrodisiac. (*Dutt's Hindu Materia Medica*, p. 148.) Similar properties are ascribed to the seeds (Hab-el-kulai) in Persian works. In the Concan a paushtik for spermatorrhœa is made by powdering the seeds of Gorí Kuhili (cultivated mucuna) and *Tribulus terrestris*, the roots of *Eriodendron anfractuosum* and *Asparagus adscendens*, emblic myrobalans, Tinospora starch, and sugar-candy, in equal proportions; of this powder 6 massa with 2 tolás of ghi are given in cow's milk twice a day. The root is considered a nervine tonic, and is prescribed in paralysis. The Sanskrit names of the plant are Atmagupta, "having hidden properties," Kapikachchhu, "monkey's itch," and Vánari, "monkey plant." According to Ainslie, a strong infusion of the root, sweetened with honey, is given by the Tamil doctors in cholera. The use of the hairs of the Mucuna pod as a vermifuge to expel ascarides appears to have originated in the West Indies, no mention of such an employment of them being found in native Indian works.* They were introduced to the notice of English physicians by Bancroft about 1769, and were probably first used in India upon their admission into the Edinburgh and London *Pharmacopœias* (1783-1809). They are now official in the Indian *Pharmacopœia*, but are hardly ever prescribed in this country. Still there is a considerable demand for the article in the Indian market for exportation to Europe, and it is supposed to be required for the preparation of some patent vermifuge.

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* In the Wanaushadi Prakásha, a Marathi work which describes the domestic remedies of the Concan, their use with gúr as an anthelmintic is mentioned, but as this work is of very recent date, the practice may have been introduced.

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Description.—The pods are slightly curved like the letter S, 3 to 4 inches long, and contain from 4 to 6 seeds of a dark brown colour and of the shape of a kidney bean. The valves are covered with rigid brown hairs about $\frac{1}{10}$th of an inch long, which give rise to much irritation of the skin if handled.

Microscopic structure.—Most of the hairs consist of a single conical cell barbed near the point, but some of them are divided by partitions. Their action appears to be simply mechanical.

Chemical composition.—The hairs when treated with sulphuric acid and iodine assume a dark brown colour. Boiling solution of potash does not considerably swell or alter them. They are completely decolorised by concentrated nitric acid. (*Pharmacographia, 2nd Ed.*, p. 190.)

The decorticated seeds reduced to fine powder and dried at 100 C. lost 10·26 per cent. in weight. The ash amounted to 4·02 per cent. The cortical portion of the seeds contained 7·80 per cent. of moisture and 3·12 of ash. Manganese was only present in minute traces in the decorticated seeds, the cortical portion, on the other hand, contained a very marked amount. The examination of the pounded entire seeds was conducted by Dragendorff's method :—

Petroleum ether extract	3·08	per cent.
Ether extract	·08	,, ,,
Absolute alcohol extract	2·12	,, ,,
Aqueous extract	31·92	,, ,,

The petroleum ether extract was very pale yellow and thick, non-crystalline, and without odour. In 98 per cent. alcohol it was partly soluble, the solution being acid in reaction. The extract consisted chiefly of a free fatty acid and its glyceride, probably oleic acid.

The ether extract was slightly yellow and non-crystalline; it was insoluble in dilute acids. In aqueous ammonia it was partly soluble with yellow coloration; the addition of acids caused the separation of white flocks of acid resin. The alcoholic-extract was yellow, and darkened somewhat on exposure.

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It did not give any reaction for alkaloids; with ferric chloride it gave a green coloration. The aqueous extract gave marked indication of the presence of albumin; it did not reduce an alkaline copper solution on boiling. The solution was strongly acid in reaction; the nature of the organic acid was not determined.

Mucuna monosperma, *DC., Wight in Hook. Bot. Misc. ii.*, 346, *Suppl., t.* 12; *Wall. Ill. As. Rar. iii.*, 19, *t.* 236; a plant of the Eastern Himalaya, tropical Zone, W. Peninsula, and Ceylon; *Vern.* Songárvi, Mothi-kuhili (*Mar.*), Thelu-kodi (*Tam.*), bears a large, flat, nearly circular seed, with a rough, black testa, 1 inch or more in diameter; the whole of its convex margin is occupied by the hilum. The pods are semi-oval, obliquely plaited, one-seeded, and armed with formidable stinging hairs of a golden brown colour. It is used as an expectorant in cough and asthma, and applied externally as a sedative. (*Peters.*)

CYLISTA SCARIOSA, *Ait.*

Fig.—*Roxb. Cor. Pl. i. t.* 92; *Wight Ic. t.* 1597.

Hab.—Concan, Deccan, Canara and Orissa. The roots.

Vernacular.—Ránghevada [illegible]*ar.*). This plant is the sole representative of the genus Cylista, and is a perennial twiner growing among bushes, with ternate leaves, having oval, pointed and entire leaflets with short white pubescence, very dense on the under-surface. The yellowish-red flowers, about half an inch long, borne on erect bracted recemes, are remarkable for their large papery calyx, which is much more conspicuous than the corollas, and is deeply four-cleft; the upper segment being two-lobed, the lateral ones much smaller, and the lowest very large, all of them beautifully veined. The little oval one-seeded pod is completely enveloped in the peculiar calyx, which affords the most marked character in the genus. (*Fl. Brit. Ind.* ii., 219; *A. A. Black in Treasury of Botany* i. 371.) This plant is called by the natives of the Concan रानघेवडा (*Rán-ghevada*), a word compounded of Rán (*wild*) and

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Ghévada, the name of a kind of *Dolichos Lablab* (5th var. of Roxburgh). The root, which is woody and tapering, is collected by the herbalists and sold as a remedy for dysentery and leucorrhœa; it is also applied externally along with other drugs to reduce tumours. Its most remarkable property is astringency; a reddish viscid juice issues from it when cut, which on drying becomes black and brittle, and may be seen adhering to the short pieces of the dry root which are offered for sale.

Description of Root.—A tapering woody root, upper portion 2 inches or more in diameter, dark brown, marked by very numerous circular light coloured scars which do not extend round its entire circumference. The transverse section shows three layers of porous woody tissue of a reddish colour, the central pith and medullary rays being light coloured; in the dry drug the section is obscured by the black exuded juice. Taste astringent and bitterish.

Chemical composition.—Powder light brown, turning pink by exposure. A decoction of the root became purple with ferric chloride and a bulky precipitate separated; it also struck a blue colour with iodine: tannin and starch were thus indicated. More exact determinations showed that the drug yields 23 per cent. of aqueous extract containing 9·9 per cent. of tannin, and 25 per cent. of alcoholic extract with 13·7 per cent. of soluble and insoluble tannins. An insignificant amount of soft yellow tenacious resin was removed by ether. No alkaloidal principle was detected.

ERYTHRINA INDICA, *Lam.*

Fig.—*Wight Ic.*, *t.* 58; *Rheede Hort. Mal. vi.*, *t.* 7. Coral tree (*Eng.*), Arbre de corail (*Fr.*).

Hab.—Throughout India. Leaves and bark.

Vernacular.—Púngra, Párangá, Mándár (*Hind.*, *Mar.*), Pálitá-mándár (*Beng.*), Kaliyana-murukku (*Tam*), Bádidapu-chettu, Bádchipa-chettu (*Tel.*), Páraválada-mara, Harwana, Warjippe (*Can.*).

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History, Uses, &c.—The Indian Coral tree, in Sanskrit Páríjáta or Párijátaka and Mándára, is supposed to flower in Indrá's garden. An episode in the Puranás relates the quarrels of Rakhmini and Satyabháma for the possession of the flowers which Krishna had stolen from the garden. The leaf is supposed to represent the Hindu trinity, the middle leaflet is Vishnu, on his right is Brahma, and on his left Shiva. The Portuguese have named them "Folhas da Trinidade." Rheede says that the leaves are discutient, and that their juice is given for syphilis. Rumphius relates that the leaf-juice is applied to ulcers to clean them, and that cooked with cocoanut milk the leaves are used internally and externally as a galactagogue and emmenagogue. The bark is used in dysentery. (*Hort. Amb. iii.*, 33.) Loureiro and Wight state that the bark is used as a febrifuge. Dr. Kani Lal Dé, in a communication to the Calcutta Exhibition Catalogue, says:—"It is anthelmintic and useful as a collyrium in ophthalmia. The leaves are applied externally to disperse venereal buboes and to relieve pain in the joints." In the Concan, the juice of the bark and young leaves is used to kill worms in sores and to disperse tumours; the young roots of the white-flowered variety are pounded and given with cold milk as an aphrodisiac. MM. Corre and Lejanne (*Resumé de la Mat. Med. Coloniale*) state that the bark is expectorant and febrifuge, and the leaves laxative and diuretic. In the Brazils the bark is used as a hypnotic.

The first physiological experiments made with the bark of this tree were those of MM. Bochefontaine and Rey, who communicated the results arrived at by them to the Académie des Sciences in 1881; they concluded that the drug acts upon the central nervous system so as to diminish or abolish its functions.

MM. Pinet and Duprat resumed the study of the action of this drug upon frogs in 1886, and communicated the following results to the Société de Biologie:—One centigram of the watery extract of the bark was introduced under the skin of the right hind leg of a frog, weighing 30 grams. This caused considerable local irritation, but at the end of 25 to 30 minutes the frog remained motionless; placed on its back it remained in that

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position, only occasionally making slight spontaneous movements: if a limb were pinched only very feeble reflex movements were induced. When the left sciatic nerve was excited by a Pulvermacher's clamp, the distant end of the divided nerve responded to the stimulus, whilst the near end was hardly affected. The electric contractability of the muscles was diminished, and reflex action abolished. Respiration became very slow and was sometimes suspended. Moreover the heart was observed to dilate very slowly, and the ventricle at the time of systole, which had become imperfect, assumed a folded appearance, and at the diastole the heart presented a marbled appearance, pale in some places and red in others. The strength of the contractions was not much affected.

At the end of 35 to 40 minutes the heart recovered its normal condition. (*Les Nouveaux Remèdes, Sept.* 15*th*, 1886.)

Description.—The fresh bark has a smooth grey suber, and bears small fissured corky lenticels arranged in perpendicular rows. On rubbing off the thin suber a green surface is exposed. The outer portion of the bark is granular and brittle, the inner consists of numerous layers of liber cells interlaced so as to form an open network. The bark has a disagreeable flavour, but is not bitter.

Chemical composition.—A decoction of the bark has no distinct odour or taste, and is not affected in colour by iodine or ferric chloride. Spirit dissolved out two resins, one soluble, the other insoluble in dilute alkali, and a bitter alkaloid. The alkaloid is best prepared by rendering alkaline the aqueous solution of the alcoholic extract and shaking with chloroform, the amorphous slightly coloured base is left on dissipation of the solvent. The alkaloid is very soluble in spirit, benzol and acid solutions, and only slightly soluble in ether and water. It gives coloured precipitates with hydrargyrate of potassium, iodine in potassium iodide and tannin, white precipitates with ammonia and soda. Oxidizing agents as potassium bichromate or manganese oxide with sulphuric acid produce with it a transient purple solution; sulphuric acid alone forms a red, and

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nitric acid a yellow colour. The hydrochlorate is crystalline and deliquescent, and the alkaloid is subject to decomposition from prolonged heating or if evaporated with an excess of acid.

Since the discovery of the above alkaloid by one of us, we have learnt that an alkaloid, *Erytherine*, having somewhat similar properties, has been found by Dr. F. Allamirano in the same tree growing in Mexico (*Pharm. Post.*, *June 23rd*, 1889.) Dr. Allamirano recommends it as an antidote for strychnine; with the previous administration of erytherine in 6 decigram doses, poisonous doses of strychnine, he says, may be taken without any danger.

BUTEA FRONDOSA, *Roxb.*

Fig.—*Roxb. Cor. Pl.*, 21, *t.* 21; *Bentl. and Trim.*, *t.* 79. Bastard teak (*Eng.*), Butéa touffu (*Fr.*).

Hab.—Plains of India. The flowers, leaves, seeds and gum.

Vernacular.—Palás, Dhák (*Hind.*), Palásha (*Mar.*), Khákar (*Guz.*), Pálásh (*Beng.*), Purashu, Murukkan-Maram (*Tam.*), Modugachettu, Palàshamu (*Tel.*), Muttaga-mara (*Can.*).

The seeds, Palás-ke-binj (*Hind.*), Murukkan-virai (*Tam.*), Moduga-vittula (*Tel.*), Muttaga-bija (*Can.*), Palásha-che-bi (*Mar.*), Paláspáparo (*Guz.*).

The gum, Palás-ki-gond, Kamarkas (*Hind.*, *Beng.*), Palásha-gonda (*Mar.*), Khákar-no-gond, Kakria-gond (*Guz.*), Murukkan-pishin (*Tam.*), Moduga-banka (*Tel.*), Muttaga-gonda (*Can.*)

History, Uses, &c.—This tree has long been known to the Hindus under the Sanskrit name of Palásha, as possessing valuable medicinal properties. It is also a sacred tree, being called the treasurer of the gods and of sacrifice; from its wood are made sacred utensils and the staff of the Brahmin which is placed in his hand on the day of the Sodmunj. The red flowers are offered in the temples at the bloody sacrifices of the goddess Káli. The leaf, like that of *Erythrina indica*, is supposed to represent the Hindu trinity, and is used for making the platters required at the Chaul ceremony, when the last tuft of hair being removed, the Brahmin boy becomes a Sádhu and must eat from a leaf platter (Brahma-pattra).

The dry twigs of the plant called Samidhás are used to feed the *Hom*, or sacred fire. The tree is also known in Sanskrit as Lâkshataru or "lac tree," because large quantities of lac are collected from its branches. Its flowers are likened by the Buddhists to penitents dressed in red. A strophe of the Saptashataka says—"In the spring the earth shines with the flowers of the Palasha as if it were covered with Bhikshus." It is the anthropogonic tree of several castes. In the Bhavaprakasa the use of the seeds of Palása as an aperient and anthelmintic is noticed; they are directed to be beaten into a paste with honey for administration. Sárangadhara also recommends them as an anthelmintic. The use of the gum as an external astringent application is mentioned by Chakradatta; it is directed to be combined with other astringents and rock salt. He recommends this mixture as a remedy for pterygium and opacities of the cornea. The author of the Makhzan-el-Adwiya describes the leaves of Palás as very astringent, tonic, and aphrodisiac, and says that they are used to disperse boils and pimples, and are given internally in flatulent colic, worms and piles. The flowers are astringent, depurative, diuretic and aphrodisiac; as a poultice they are used to disperse swellings and promote diuresis and the menstrual flow. The seed is anthelmintic, and, combined with astringents and rock salt, as already mentioned, is used to remove white spots from the cornea. (Cf. *Makhzan, article Palás.*) Ainslie notices the use of the seeds by Tamil practitioners as an anthelmintic, in doses of a tablespoonful and a half twice daily, both in cases of tapeworm and asçarides. He quotes Roxburgh's description of the gum and flowers, but remarks that the natives appear to make no use of either of them. From the Hortus Malabaricus, it appears that the bark is given in conjunction with ginger in cases of snake-bite. Dr. Sherwood informed Ainslie that a decoction of the seeds with nitre was prescribed in gravelly complaints by native practitioners. In India at the present

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time the gum is much used as a substitute for kino by natives and Europeans with satisfactory results. We have tried the seeds as an anthelmintic, and are inclined to think favourably of them; they have an aperient action. An infusion of two or three seeds is used for this purpose. When pounded with lemon-juice and applied to the skin they act powerfully as a rubefacient. We have used them successfully for the cure of the form of herpes known as Dhobie's itch. In the Concan a poultice of the flowers boiled in water is applied to the abdomen in difficult micturition, and two tolás of the water with nitre is given internally. Dr. Fancourt Willis informs us that the Arab horse-dealers put one seed into each feed of corn to keep their horses in condition.

Description.—The leaves are spreading and ternate, from 8 to 16 inches long, leaflets emarginate, or rounded at the apex, leathery above, shining and pretty smooth below, slightly hoary, entire, the pair are obliquely oval, from four to six inches long, and from three to four and a half broad, the exterior one obovate, and considerably larger than the lateral ones; the flowers are very large, papilionaceous, their colour a beautiful deep red, shaded with orange and silver coloured down*; seeds flat, about 1½ inch long, 1 inch broad and 1-16th inch thick; testa dark reddish brown, thin, smooth, veined; hilum prominent; cotyledons large and leafy, surface veined; radicle small, taste a little acrid. The gum occurs in commerce as small, flattish or angular fragments of a very deep ruby colour, and unless held between the eye and the light seems to be opaque; it is mixed with numerous small particles of light grey corky bark; the taste is purely astringent. The secretion in a fresh state is ruby-coloured, and is soluble for the most part in water; when kept for some time

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* Amir Khusru, the Turkoman poet, likens the flowers to a lion's claws stained with blood—

پنجه کشاده گل لعل پلر   غرق خون ناخن شیویلر

The Palch expands its clutches of red flowers like the claws of the fierce lion steeped in blood.

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it darkens in colour, and swells up like bassorin, and only partially dissolves. Both fresh and commercial samples behave in the same manner with rectified spirit, giving up less than half their weight of tannin to the solvent, and leaving a large quantity of insoluble gum.

Chemical composition.—According to Hanbury, Butea gum yields 1·8 per cent. of ash, and contains 13·5 per cent. of water. Ether removes from it a small quantity of pyrocatechin. Boiling alcohol dissolves it to the extent of 46 per cent; the solution which is but little coloured produces an abundant greyish green precipitate with perchloride of iron, and a white one with acetate of lead. It may be hence inferred that a tannic acid, probably kino-tannic acid, constitutes about half of the weight of the drug, the remainder being a soluble mucilaginous substance. Butea kino submitted to dry distillation yields pyroçatechin. According to Eissfeldt it does not contain pyrocatechin, but yields it on dry distillation.

Roxburgh states that he obtained an extract by evaporating the juice of the flowers diluted with alum water and rendered clear by depuration, which proved a brighter water colour than gamboge. He further says that infusions of the dried flowers yielded an extract very little, if any thing, inferior to that made from the fresh juice. These extracts after being kept for a year remained perfectly bright. The flowers are used as a dye stuff in Bengal and are exported to the N.-W. Provinces. The oil of the seeds is yellow, sp. gr. 0·917; it is nearly tasteless, and solidifies at 10°. (*Lepine.*) Braunt gives 0·927 as the specific gravity The seeds have been examined by N. Waeber (*Pharm. Zeitschr. für Russland*, 1886); the results of the analysis are as follows, alkaloids and glucosides were not found—

Moisture	6·62
Ash	5·14
Fat	18·20
Wax soluble in ether	0·25
Albuminoids sol. in water	9·12
„ sol. in soda	1·95

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Albuminoids insol. in water and soda ...	8·49
Substance apparently nitrogenated, soluble in alcohol	0·82
Mucilage	2·28
Glucose..	6·87
Organic acids	4·00
Other substances soluble in water.........	2·16
Metarabic acid and phlobaphene	10·10
Cellulose	3·80
Other insoluble substances..................	22·20

Commerce.—The gum, seeds and dried flowers are articles of commerce. Value, gum, 3 as. per lb.; seeds, Rs. 2½ per maund of 37½ lbs.

Butea superba, *Roxb.*

Cor. Pl. 23, *t.* 22.

Hab.—Concan, Bengal, Orissa, Burma.

Vernacular.—Tiwat, Tiwas, Palás-vél (*Mar.*), Palás-lata (*Hind.*, *Beng.*), Kodi-murukkan (*Tam.*), Tige-moduga (*Tel.*), Balli-muttaga (*Can.*), Vel-khákar (*Guz.*), is a scandent shrub very closely resembling *B. frondosa*, and like that plant yielding a kino-like gum. As a remedy for the poisonous bites of animals, the people of the Concan use the root with an equal proportion of the root of *Nyctanthes* and *Woodfordia floribunda*, the seeds of *Cassia Tora* and *Vernonia anthelmintica*, and the stem juice of *Trichosanthes palmata* made into a paste with cow's urine, as a local application, and administer *Aristolochia indica* internally. In the heat eruptions of children the leaf-juice is given with curds and yellow zedoary. Mr. Prebble informs us that **B. minor** also yields a kino.

CLITORIA TERNATEA, *Linn.*

Fig.—*Bot. Mag.*, *t.* 1542. Winged-leaved Clitoria (*Eng.*), Clitoria de Ternate. (*Fr.*).

Hab.—From the Himalayas to Ceylon and Burma. The root and seeds.

Vernacular.—Kava-thenthi (*Hind.*), Aprajita (*Beng.*), Kájali, Gokaran (*Mar.*), Garani (*Guz.*), Kakkanan-kodi (*Tam.*), Dintana (*Tel.*), Karnike (*Can.*).

History, Uses, &c.—The plant is called in Sanskrit Aparajita or Gokarna, both are names for Shiva, to whom the flowers are sacred in common with those of the species of Sesbania having flowers of a somewhat similar shape; typical of his representation as the Ardha-nári or hermaphrodite god. Rumphius calls Clitoria, Flos cæruleus, and says that in Ternate it is known as *Sajà Cotele* and *Bokyma Cotele, i.e.* Flos clitoridis and Clitoris principissæ; he gives Fula criqua as the Portuguese name. (*Hort. Amb.* vii., 30.) Sanskrit works on Materia Medica describe the root as aperient and diuretic, and direct it to be used in combination with other diuretics and laxatives in ascites and enlargements of the abdominal viscera. The Mahometans have given it the name of Mázeriyun-i-Hindi (Indian Mezereon) on account of its purgative and diuretic properties. We may mention here that their mezereon is used to remove dropsical enlargements of the abdomen, and is not the same drug as the mezereon of our *Pharmacopœia.*

Ainslie mentions the use of the root in croup, given with the object of causing nausea and vomiting. In the Concan two tolás of the root-juice are given in cold milk to remove the phlegm in chronic bronchitis; it causes nausea and vomiting. The juice of the root of the white-flowered variety is blown up the nostrils as a remedy for hemicrania. The author of the Bengal Dispensatory after extensive experiments denies its emetic properties, but says that an alcoholic extract proved a brisk purgative in doses of from 5 to 10 grains; he found it however to give rise to griping and tenesmus, and does not recommend its use. Mr. Moidín Sheriff speaks highly from personal experience of the root bark in doses of from one to two drachms in infusion as a demulcent in irritation of the bladder and urethra. It acts at the same time as a diuretic and in some cases as a laxative. The seeds appear not to have been used medicinally by the natives, but attention

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has been drawn to their purgative properties in the *Pharmacopœia of India,* and there would seem to be but little doubt that their action is mild and safe; they should be administered in combination with twice their bulk of acid tartrate of potash and a little ginger, and in the same doses as compound jalap powder. The seeds were first brought to England from the island of Ternate, one of the Moluccas, hence the specific name of the plant. Haines has recommended a syrup of the deep blue flowers as a colouring agent, and a tincture as a substitute for litmus.

Description.—The fresh root is white, fleshy, often one inch or more in diameter, but pieces the size of a quill are preferred; it has an acrid taste. The root bark is soft, thick and fibrous and easily separated; the central portion of the root is composed of very large pitted vessels easily visible to the naked eye. The seeds are rather more than 2-8ths of an inch long and resemble vetch seeds; they are mottled green and black. The testa is hard and contains two cotyledons made up of elongated thin-walled cells full of large starch granules; they have an acrid, bitter taste.

Chemical composition.—Ether dissolves out a yellow resin soluble in alcohol and alkaline solutions, and apparently crystalline when carefully evaporated. Subsequent treatment of the drug with rectified spirit removes an amorphous, reddish-brown acid resin and a quantity of alkaline chlorides which leave a deposit of cubical crystals on concentrating the clear liquor. This resin forms 4 per cent. of the root bark. It is soluble in alkalies with a red colour, and is reprecipitated by acids with discharge of the colour. It forms brown solutions with concentrated nitric and sulphuric acids. Although this resin is not dissolved out of the drug by ether, a soda solution precipitated by acid and shaken up with ether leaves no insoluble residue. The root bark contains starch, and a tannin giving a blue-black precipitate with ferric chloride, and yields 12 per cent. of ash. No alkaloid was detected in either the ethereal, alcoholic, or aqueous extracts.

The seeds of **C. ternatea** contain 12·8 per cent. of moisture and 6 per cent. of ash. Ether removes a bland greenish fixed oil and a light brown resin. Alcohol extracts a bitter acid resin, apparently the active principle, a tannic acid giving a blue-black colour with ferric chloride, and a large proportion of glucose. Water alone dissolves the acrid principle, which is precipitated by iodine solution, readily decomposes with the formation of sugar, and in other respects resembles a glucoside.

Commerce.—The dried root is to be found in the shops sometimes.

Dalbergia sympathetica, *Nimmo, Jour. Linn Soc. iv., Suppl.* 42, a plant of the Western Peninsula. Pentgul (*Mar.*), Titábli (*Goa.*).

The leaves are used in Goa as an alterative. It is a very remarkable scandent shrub; the stem studded thickly with large blunt thorns, often nine inches long, some of them contorted so as to assist in supporting it upon high trees; the leaves are pinnate, 4 to 6 inches long, the leaflets delicate, obtuse or emarginate, ½ to 1 inch long, thinly silky at first, especially beneath; the flowers are in short, axillary cymes; calyx 1-12th of an inch long, silky, with a pair of small obtuse, adpressed bracteoles; teeth short, obtuse; corolla twice the length of the calyx, yellowish white; pod generally one-seeded, membranous, obtuse, about 2 inches long and ¾ of an inch broad with an unusually short stalk. The bark is used as a *lép* to remove pimples. The foliage resembles that of the Tamarind, and is eaten by cattle. The flowers appear in February and March. Rheede's name for the plant is *Ana Mullu.*

In the Concan the juice of the leaves of *D. volubilis, Roxb.,* Alei (*Mar.*), is applied to aphthæ, and used as a gargle in sore throat. The root-juice with cummin and sugar is given in gonorrhœa.

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PTEROCARPUS SANTALINUS, *Linn. fil.*

Fig.—*Bedd. Fl. Sylv., t.* 22; *Bentl. and Trim., t.* 82. Red Sanders (*Eng.*), Santal rouge (*Fr.*).

Hab.—Western Peninsula. The wood.

Vernacular.—Ragat-chandan, Lal-chandan (*Hind.*), Raktachandan, Tambara chandana (*Mar.*), Shen-shandanam (*Tam.*), Erra-gandhapu-chekka, Rakta-gandham (*Tel.*), Rakta-candana, Kempu-gandha-chekke (*Can.*), Rakta-chondon (*Beng.*), Ratánjli (*Guz.*).

History, Uses, &c.—According to Sanskrit writers there are three kinds of sandalwood, Srikhanda or white, Pitachandana or yellow, and Raktachandana or red. The first two are the dark and light-coloured wood of *Santalum album.* Upon the subject of red sandalwood, Dutt (*Materia Medica of the Hindus*, p. 154,) has the following remark:—"It has been a question how the wood of *Pterocarpus santalinus*, which is nearly inodorous, came to be called by the name of Raktachandana in Sanskrit and the vernaculars of India. I am inclined to think that it is owing to the similarity in the uses to which the Hindus put both these articles. Both sandalwood and red sandalwood are rubbed on a piece of stone with water, and the emulsions used after bathing and in religious services." Hindu physicians consider red sandalwood to be astringent and tonic; they use it as a cooling application to inflamed parts and to the head in headache; as an external application it is supposed to be more powerful than white sandalwood, given internally to be less, so the two are often combined, and are considered to have similar properties. Mahometan writers follow the Hindus in describing the three kinds of sandalwood and their uses. The author of the *Shafa-el-askam* says that in bilious fluxes white sandal is used, when blood is being passed red sandal, and when the stools contain both bile and blood the two woods are combined. This treatment must be based upon the doctrine of signatures. Red sanders wood is well known in Europe as an ingredient in French polish.

Description.—The wood sinks in water; it is dark red with black veins; thin shavings appear blood red with veins of a lighter tint if the section is a transverse one. The cells of the parenchymatous layers which connect the vascular bundles contain very large crystals of oxalate of lime visible to the naked eye; all parts of the wood are full of colouring matter.

Chemical composition.—Red sandalwood was first examined by L. Meier, who obtained from it a red crystalline principle to which he gave the name of *Santaline.* Meier obtained this substance by exhausting the wood with ether, the extract thus obtained was then washed with water, dissolved in alcohol, and the alcoholic solution precipitated by acetate of lead, on the removal of the lead the liquid yielded the santaline.

Weyermann and Hæffely assigned the formula $C^{15} H^{14} O^{5}$ to this resinoid substance.

Weidel (1870) exhausted the wood with boiling water containing a little potash and obtained by means of hydrochloric acid a red precipitate, which was redissolved in boiling alcohol and then furnished *colourless* crystals of *Santal* $C^{8} H^{6} O^{3} + \frac{1}{2} H^{2} O$, which when acted upon by alkalies yielded protocatechuic acid and carbonic acid, like piperonal, with which it is isomerous. Upon completely exhausting sandalwood, Weidel also obtained a partially crystalline red substance distinct from colourless santal and from the santaline of Meier; to this substance he assigned the formula $C^{14} H^{12} O^{4}$. In 1878, Franchimont and Sicherer isolated from sandalwood an amorphous principle melting at about 104° and having the composition $C^{17} H^{16} O^{6}$. Three years previous to the experiments of Franchimont, P. Cazeneuve by exhausting with ether at 56° an intimate mixture of the powdered wood with slaked lime, had obtained a finely crystalline body having the formula $C^{12} H^{10} O^{3}$. This substance, which differed from those already mentioned, was in reality a mixture which Cazeneuve and Hugounenq in 1887 separated into pterocarpine and homopterocarpine, the latter substance being very soluble in cold bisulphide of carbon, whilst the former is only so in excess of

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boiling bisulphide. Pterocarpine is a white crystalline substance insoluble in water and cold alcohol, but soluble to some extent in boiling alcohol, it is slightly soluble in boiling ether, which deposits it on cooling in crystalline flakes; it crystallizes from chloroform in fine prisms.. A solution of 4·64 grms. in 100 c.c. of chloroform, is strongly levogyre $[a]_j = -211^\circ$., heated to 145° it softens and melts at 152°, turning slightly yellow. Formula $C^{10} H^{8} O^{3}$; it is neutral to reagents; insoluble in acids and boiling liquor potassæ, but is acted upon by fused potash evolving a coumarin odour. Nitric acid forms with it a green solution.

Homopterocarpine has the same general properties. Formula $C^{12} H^{12} O^{3}$. MM. Cazeneuve and Hugonnenq consider that both of these substances are allied to the Coumarins.

Commerce.—Red sandalwood comes from Southern India, the felling of the trees is under Government control, and they yield a considerable revenue. It is imported into Bombay and Calcutta from the Malabar Coast. Value, Rs. 15 to 28 per kandy of 7½ cwts. The variation in price depends upon the quantity in the market.

PTEROCARPUS MARSUPIUM, *Roxb.*

Fig.—*Roxb. Cor. Pl. ii., t.* 116; *Bedd. Fl. Sylv., t.* 21; *Bentl. and Trim., t.* 81. Indian Kino tree (*Eng.*), Ptérocarpe à bourse (*Fr.*).

Hab.—Western Peninsula, Ceylon. The gum.

Vernacular.—Bija, Bijasár (*Hind.*), Bibla, Honné (*Can.*) Asán (*Mar.*), Vengai-maram (*Tam.*), Peddagi (*Tel.*).

History, Uses, &c.—Neither Hindu or Mahometan medical writers appear to notice Malabar kino. Rumphius (iii., 24,) calls the tree *Pterocarpus indicus*, and remarks that the gum looks like dried blood, and cures diarrhœa; he also says that the bruised leaves are applied to boils, sores, and skin eruptions.

Ainslie notices the use of the gum by the natives on the Coromandel Coast as a remedy for toothache, but does not call it kino, and it would appear not to have been an article of export to Europe in his time. From the *Pharmacographia* we learn that kino originally came from the river Gambia in West Africa under the name of *Gummi rubrum astringens Gambiense*, and that it was produced by a tree called in the Mandingo language *Kano*, and which was afterwards identified with the *Pterocarpus erinaceus* of Poiret. In the *Edinburgh Dispensatory* of 1803, kino is described as coming from Africa and Jamaica, but in the 1811 edition, Duncan says that the African drug is no longer to be met with, its place being supplied by kinos from Jamaica, the East Indies, and New South Wales. After this date the East Indian drug appears to have been principally used, and when Wight and Royle (1844-46) proved its botanical origin it became recognised as the legitimate kino of the principal Pharmacopœias of Europe. A description of its collection on the Malabar Coast will be found in the *Pharmacographia*. In the Canara District of the Bombay Presidency it is collected in little cups made with leaves, and consequently assumes the form of concavo-convex cakes, 3 to 4 inches in diameter; these are always broken up and garbled by the wholesale dealers. Malabar kino is mostly reserved for the European market, there is little demand for it in native practice, Dragon's blood and Butea kino taking its place. The bark of the tree is used in Goa as an astringent, but the gum is not collected. Kino is more lenitive than other astringents, in consequence, probably, of the phlobophene it contains; it is chiefly used in the treatment of diarrhœa and pyrosis.

Description.—Kino as offered for sale is in blackish-red angular fragments full of cracks. If a thin fragment is held between the eye and the light it is seen to be of a rich garnet colour. The greater part of it is soluble in cold water and all in boiling water, but a portion is deposited on the water cooling. Rectified spirit dissolves kino, forming a deep red tincture which often gives trouble by becoming gelatinous if

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kept for any time. The addition of a little glycerine will prevent this.

Chemical composition.—The following account is extracted from the *Pharmacographia*:—"Cold water forms with kino a reddish solution, which is at first not altered if a fragment of ferrous sulphate is added. But a violet colour is produced as soon as the liquid is cautiously neutralized.

"This can be done by diluting it with common water (containing bicarbonate of calcium) or by adding a drop of solution of acetate of potassium. Yet the fact of kino developing an intense violet colour in presence of a protosalt of iron, may most evidently be shown by shaking it with water and iron reduced by hydrogen. The filtered liquid is of a brilliant violet, and may be evaporated at 100° without turning green; the dried residue even again forms a violet solution with water. By long keeping the violet liquid gelatinizes. It is decolorized by acids, and turns red on addition of an alkali, whether caustic or bicarbonated. Catechu, as well as crystallized catechin, show the same behaviour, but these solutions quickly turn green on exposure to air.

"Solutions of acids, of metallic salts, or of chromates produce copious precipitates in an aqueous solution of kino. Ferric chloride forms a dirty green precipitate, and is at the same time reduced to a ferrous salt. Dilute mineral acids or alkalies do not occasion any decided change of colour, but the former give rise to light brownish red precipitates of kino-tannic acid. By boiling for some time an aqueous solution of kino-tannic acid, a red precipitate, kino-red, is separated.

"Kino in its general behaviour is closely allied to Pegu catechu, and yields by similar treatment the same products, that is to say, it affords pyrocatechin when submitted to dry distillation, and protocatechuic acid together with phloroglucin when melted with caustic soda or potash.

"Yet in catechu the tannic acid is accompanied by a considerable amount of catechin, which may be removed directly by exhaustion with ether. Kino, on the other hand, yields to ether only a minute percentage of a substance, whose scaly crystals display under the microscope the character of pyrocatechin, rather than that of catechin, which crystallizes in prisms. The crystals extracted from kino dissolve freely in cold water, which is not the case with catechin, and this solution assumes a fine green if a very dilute solution of ferric chloride is added, and turns red on addition of an alkali. This is the behaviour of catechin as well as of pyrocatechin; but the difference in solubility speaks in favour of the crystals afforded by kino being pyrocatechin rather than catechin.

"We thought pyrocatechin must also occur in the mother-plant of kino, but this does not prove to be the case, no indication of its presence being perceptible either in the fresh bark or wood Etti (1878) extracted from kino colourless prisms of kinoïn by boiling the drug with twice its weight of hydrochloric acid, about 1·03 sp. gr. On cooling, kino-red separates, very little of it remaining in solution together with kinoïn. The latter is extracted by exhausting the liquid with ether, which by evaporation affords crystals of kinoïn. They should be recrystallized from boiling water; they agree with the formula $C^{14} H^{12} O^{6}$, which is to be regarded as that of a methylated gallic ether of pyrocatechin, *viz.*, $C^{6} H^{4} (OCH^{3}) C^{7} H^{5} O^{5}$. Kinoïn by heating it to 130° C. gives off water and turns red; $2C^{14} H^{12} O^{6} = O H^{1} C^{28} H^{22} O^{11}$. The latter product is an amorphous mass agreeing with kino-red; by heating it at 160 to 170° it again loses water, thus affording another anhydride. Etti succeeded in preparing methylic chloride, pyrocatechin, $(C^{6} H^{4} OH)^{2}$, as well as gallic acid, $C^{7} H^{6} O^{5}$, by decomposing kinoïn.

"We have prepared kinoïn from Australian kino, but failed to obtain it from Malabar kino, which Etti says he used. Kino affords about 1½ per cent. of kinoïn. The solutions of kinoïn turn red on addition of ferric salts. Commercial kino yielded us 1·3 per cent. of ash." (*Pharmacographia, 2nd Ed.*, p. 196.)

Commerce.—Kino is chiefly collected on the Malabar Coast, and exported from Cochin direct to Europe. A false kino similar in appearance to that of Malabar, but very insoluble in water and spirit, has been recently met with in the Bombay market. Good kino should dissolve readily in rectified spirit.

PONGAMIA GLABRA, *Vent.*

Fig.—*Jard. Malm., t.* 28; *Wight Ic., t.* 59; *Bedd. Fl. Sylv., t.* 177.

Hab.—India, most abundant near the coast.

Vernacular.—Karanj, Kiramál (*Hind.*), Dahar-karanja (*Beng.*), Karanja (*Mar.*), Pungam-maram (*Tam.*), Ranagu, Kanuga-chettu (*Tel.*), Honge (*Can.*).

History, Uses, &c.—This is a handsome flowering tree with foliage like the Beech. Sanskrit writers call it Karanja and Naktamála or Naktamálaka, "garland of the night," and in Hindi it is sometimes called Sukhchain, "affording perfect satisfaction to the senses"; indeed, it well deserves these names, as nothing can be more beautiful than its drooping branches of shining green leaves laden with racemes of rose-coloured flowers. The seeds, leaves, and oil are used in Hindu medicine as a remedy for skin diseases and rheumatism and to destroy worms in sores. Chakradatta mentions a paste made of the seeds along with those of *Cassia Tora* and the root of *Saussurea Lappa* as a useful application to skin diseases. He also gives prescriptions for a compound oil and ghrita to be used for the same purpose (*see Dutt's Mat. Med.*, p. 153), where the original prescriptions are given with a translation.

Rheede notices the use of a bath prepared with the leaves, to remove rheumatic pains; and they appear to be in general use for this purpose. Ainslie says that the juice of the root is used for cleansing foul ulcers, and closing fistulous sores. He also notices the oil and its use in itch and rheumatism. Gibson speaks very highly of the oil as a remedy in scabies, herpes, and other cutaneous diseases of a similar nature; it should be mixed with an equal quantity of lemon juice and be well shaken, when it forms a rich yellow liniment which we have used successfully in porrigo capitis, pityriasis and psoriasis. In leprosy the natives prescribe the leaves with those of Plumbago, along with some pepper and salt, to be powdered and given in curds. Karanj is also an ingredient in several complicated prescriptions for epilepsy and abdominal enlargements. Dr. P. S. Mootooswamy mentions the use of the juice of the root with cocoanut milk and lime water as a remedy for gonorrhœa in Tanjore, and of the leaves (Ponga-illai, Tamil) in flatulency, dyspepsia, and diarrhœa. He also informs us that broken rice is boiled with the leaves and those of *Morinda citrifolia,* dried in the shade, cleaned and crushed, and from this preparation a thin salt gruel is made to feed young children with instead of cow's milk, which is supposed to cause glandular enlargements of the abdomen. He has noticed the use of the flowers as a remedy for diabetes, and of the pods worn round the neck as a protective against whooping cough. (*Indian Med. Gaz.*, 1888.) Dr. B Evers has seen the seeds administered internally for the last named affection. The oil is in general use amongst the agricultural classes as a lamp oil.

Description.—Leaves pinnate, from 6 to 18 inches long, leaflets opposite, 2 to 3 pairs and an odd one, oval, pointed, entire, smooth and shining, subcoriaceous, 2 to 4 inches long, taste bitter; pod woody, ovate, compressed, glabrous, $\frac{1}{8}$ to $\frac{1}{4}$ inch thick, 1½ to 2 inches long, apex thick and blunt, point decurved, very short, it generally contains one perfect and one abortive seed; seed compressed, of the shape and size of a broad bean; testa thin, smooth, veined, light-red; cotyledons very oily, bitter. The bark has a thin ashy-grey outer layer, which readily peels off; when this is removed, the surface is seen to be green with white transverse markings. The substance of the bark is tough with a white granular fracture; odour mawkish; taste bitter and somewhat aromatic, with a peculiar pungency. Starch and rhomboid crystals are observed under the microscope. The root bark is of a rusty-brown externally, yellow within. All parts of the plant when crushed afford a yellow juice.

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Chemical composition.—According to Lepine (*Pharm. Journ.* (3) XL. 16,) the seeds yield 27 per cent. of a yellow oil, having a specific gravity of 0·945, and solidifying at 8° C.

The oil which we have examined (called Honge oil in Mysore) and expressed purposely from fresh seeds, was thick, of a light orange-brown colour, and bitter taste. The specific gravity at 18° C. was 0·9358. It yielded 93·3 per cent. of fatty acids melting at about 30°. With sulphuric acid it became yellow with orange streaks, and when stirred formed an orange-red mixture, which after standing became yellow. With nitric acid it formed an orange emulsion. With the elaïdin test it remained liquid for several hours, and was of the colour and consistence of honey after two days. The fresh oil deposits solid white fats if kept at the temperature of 16° for a few weeks, and the clear oil then has the specific gravity of 0·935 The bitter principle of the oil appears to reside in a resin and not in an alkaloid, as in the case with Margosa oil.

The bark contains a bitter alkaloid, soluble in ether, alcohol, and water; also an acid resin of a greenish-brown colour soluble in ether. The alcoholic extract is composed of a substance analogous to quinovin together with sugar. The watery extract contains much mucilage, which is gelatinized by ferric chloride. A decoction of the bark gives a blue-black colour with iodine solution; no indication of the presence of tannin could be obtained from any part of the bark.

DERRIS ULIGINOSA, *Benth.*

Fig.—*Wt. in Hook. Bot. Misc. iii., Suppl. t.* 41.

Hab.—Eastern Himalayas, Western Peninsula, Ceylon.

Vernacular.—Pánlata (*Beng.*), Kájarvel, Kirtána (*Mar.*).

History, Uses, &c.—This woody climber is the most widely-spread species of the genus, and is worthy of notice on account of the activity of its bark as a fish poison, for which purpose it is used in Zambesi-land. In India it is known to

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act as a poison upon worms and the larvæ of insects which trouble the cultivator, whence the Marathi name *Kirṭána,* or "worm-creeper."

The natives of Tanjore use it medicinally. Dr. P. S. Mootooswamy (*Indian Med. Gaz.*, 1888,) mentions a medicinal oil, in which it is an ingredient, as used internally and applied externally in paralysis, rheumatism, dysmenorrhœa, &c.; but as this ghrita (oil) contains such active ingredients as Plumbago root, Asafœtida, and Garlic, it is difficult to tell how much of its efficacy in due to the Derris.

Description.—The plant is a woody climbing shrub with pinnate leaves and pink flowers. The stem bark is dark brown and scabrous from the presence of numerous little round white corky lenticels, the bark of the root is of a lighter colour, scurfy and thickly studded with large transverse corky warts, its substance is of a greenish colour; taste acrid and astringent. The powder of the bark excites sneezing.

Chemical composition.—A proximate analysis of the bark reveals the presence of a neutral crystalline principle, a wax and two resins in the ether extract; two colouring matters, an alkaloid and glucose in the alcoholic extract; an acrid glucoside allied to saponin, together with gum in the aqueous extract, and 8 per cent. of mineral matter. The bitterish alkaloid gives a fine red colour with sulphuric acid and a violet colour with oxidizing agents; it is associated with the colouring matter soluble in water, which is of an acid nature and strikes a deep reddish brown with ferric chloride, and a reddish pink with ferrous sulphate. The glucoside is precipitated with barium hydrate with colouring matter, and the latter is left in an insoluble condition on dissolving the barium compound in hydrochloric acid; on boiling this solution the decomposition was readily effected with the formation of glucose and an insoluble body differing from sapogenin in its appearance and solubility in spirit. The resin, more soluble in rectified spirit, was dark reddish brown and freely soluble in alkali; the less soluble resin was light brown, brittle, and soluble

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only in a large quantity of alkali; they were both acid in reaction.

Tourhi Pods.—These dried pods, which are sold in the bazars of Bengal, are apparently those of a species of Derris; they vary much in size, being ½ to 2 inches in length, and from ¼ to ½ an inch in breadth. They are brittle and of a brown colour with a prominent dorsal suture.

The pods are astringent, and when powdered are used as a tooth powder and to stain the teeth. A decoction is used as an astringent injection in leucorrhœa, but their principal use is in the preparation of writing ink.

Chemical composition.—The pods with their seeds reduced to powder contained 4·73 per cent. of moisture, and 2·86 per cent. of ash; a slight trace of manganese was present.

With the exception of a very large amount of astringent matter giving a blackish coloration with ferric salts, and a resinous principle soluble in chloroform, and affording a bright yellow coloration with alkalies, nothing special was detected. No glucoside was present.

SESBANIA GRANDIFLORA, *Pers.*

Fig.—*Rheede, Hort. Mal. i., t.* 51. *Syn.*—Agati grandiflora.

Hab.—W. Peninsula. The bark and flowers.

Vernacular—Agásta (*Mar.*), Avisi (*Tel.*), Agátti (*Tam.*), Bak (*Beng.*), Agasthio (*Guz.*), Basna (*Hind.*), Agashi (*Can.*).

History, Uses, &c.—A native of the Eastern Islands, but cultivated in gardens all over India, and now quite naturalised. In Sanskrit it is called Agasti, Vranári, Vaka and Sthúla-pushpa, or "large-flowered." It is named Agasti after a rishi or sage of that name, the author of several Vedic hymns, who is said to have been the son of both Mitra and Varuna by Urvasi,* and to have conquered and civilised

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* Urvasi (hot desire), an Apsaras or nymph of Indra's heaven. According to local tradition the sage was not born of her body, but from the lust excited by her beauty. (*Ainslie.*)

Southern India. He also wrote on medicine, and his healing spirit is said still to haunt the mountains of Courtallum. To the present day his works are held in the highest estimation in the South of India. The flowers are sacred to Shiva and are supposed to represent the male and female generative organs.

The bark is very astringent, but not bitter, as stated in the *Pharmacopœia of India,* where it is recommended as a tonic by Dr. Bonavia. The statement that it is a bitter tonic occurs also in the *Bengal Dispensatory.* In Bombay the leaves or flowers are made use of by the natives, their juice being a popular remedy in nasal catarrh and headache; it is blown up the nostrils and causes a very copious discharge of fluid, relieving the pain and sense of weight in the frontal sinuses.* The root of the red flowered variety, rubbed into a paste with water, is applied in rheumatism; from 1 to 2 tolás of the root-juice are given with honey as an expectorant in catarrh; a paste made of the root with an equal quantity of Stramonium root is applied to painful swellings. The flowers are cooked and eaten as a vegetable. The leaves are said to be aperient. Rumphius states that a poultice of the leaves is so popular a remedy in Amboyna for bruises, that the tree has become notorious as the "solatium et auxilium illorum qui vapulantur," and people who plant it near their houses are laughed at on this account. It is a curious coincidence that the Sanskrit name Vranári signifies "enemy of sores" (Vrana-ari).

Description—A tree of very short duration, attaining a height of about 30 feet in a few years and then dying. The leaves are abruptly pinnated, leaflets 21 pairs or fewer, oblong-ovate, 1 to 1½ inch long; taste a little acid and astringent. The calyx is campanulate, two-lipped, flowers papilionaceous, white or red, very large and fleshy in 2 to 4 flowered axillary racemes, taste mucilaginous and bitterish, legumes pendulous, very long, slightly flattened, contracted between the seeds. The bark is much fissured longitudinally, of a greyish-brown externally, the dry suber nearly equal to the living portion in thickness; in the fissures may be seen numerous small tears of a garnet-red when fresh, but soon becoming almost black by exposure to the air. The outer portion of the living bark is of a red colour, and is loaded with the same kind of gum in a soft state.

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* This kind of medicament is the *ρίνεγχυτον* of Galen. In Scrib. Larg. Comp. 7, we read:—"Per nares ergo purgatur caput iis rebus infusis per cornu quod rhynenchytes vocatur; Hederæ succo per se, vel betæ succo, cum exiguo flore æris, vel cyclamini succo mixto lacte aut aqua pari mensura."

Chemical composition.—Tears of the red gum which adhere to the bark merely softened in water, they were also insoluble in boiling water, and in cold and boiling alcohol. They were slowly dissolved by boiling with dilute alkali, giving a brown solution when ammonia was used, and a deep claret with soda. The alkaline solution neutralized with acetic acid gave brown flocculent precipitates with lead acetate, alum, and salts of iron. A large excess of acid did not cause complete separation of the colouring matter. A filtered decoction of the bark gave a blue-black colour with ferric chloride, and a deposit with rectified spirit, showing the presence of tannin and gum.

SESBANIA ÆGYPTIACA, *Pers.*

Fig.—*Rheede, Hort. Mal. vi., t.* 27; *Wight Ic., t.* 32.

Hab.—India.

Vernacular.—Jét, Rásin (*Hind.*), Jayanti (*Beng.*), Champai (*Tam.*), Shevári (*Mar.*), Somanti (*Tel.*), Karijinange (*Can.*).

History, Uses, &c.—This plant, in Sanskrit Jaya (victorious), Jayanti (daughter of Indra), Vaijayanta (banner of Indra), Nádeyi (river-born), is extensively cultivated in India, where the stems are used as a substitute for bamboos. It is the *Kedangu* of Rheede and *Emerus* of Burmann. The Hindus have a superstition that the sight of the seeds will remove the pain of scorpion stings; they also pound them and apply them locally as an astringent. The juice of the bark is given internally as an astringent, and Wight remarks that the leaves are much used in poultices to promote suppuration. Forskahl calls the plant *Dolichos Saiseban*; it is the Saisabán of the Egyptians, who use the seeds medicinally on account of their astringent properties. Prosper Alpinus says of these seeds:—

"Et ut uno verbo dicam, in omnibus vacuationibus firmandis illorum seminum usum habent frequentissimum." Mir Muhammad Husain and others who describe the use of the seeds in India give a similar account of their medicinal properties. The generic name of the plant is Persian, and according to the Burhán, should be pronounced "Sīsībān." This the author of that work says is the same as Panjangusht (a plant generally identified with *Vitex Agnus-castus*) and called Hab-el-fakd by the Arabs. Here he agrees with Abu Hanifeh, who describes الفقد as a plant which is thrown into mead to make it strong, and is called in Persian Fanjangusht. On the other hand Ibn Arabi says El fakd is the Kushuth * (كشوث) and also a beverage (نبيذ) prepared from raisins and honey, into which the *fakd* has been thrown, to cause it to become strong. It seems probable that the Fakd of the Arabs was an astringent plant, which was used, like Acacia bark in India, for clearing spirituous liquor.

Description.—Sir W. Jones describes the flowers as varying in colour; in some plants, wholly yellow; in others, with a blackish-purple awning yellow within, and dark yellow wings tipped with brown; in some with an awning of the richest orange-scarlet externally, and internally of a bright yellow; wings yellow, of different shades; and a keel pale below, with an exquisite changeable light purple above, striated in elegant curves. The leaves are pinnate, 3 to 6 inches long, with from 9 to 15 pairs of linear-oblong leaflets. The seeds are oblong, somewhat kidney-shaped, and smooth and are contained in a tomentose pod, 6 to 9 inches in length.

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* Kushuth is described as a parasitic plant, without root or leaves, and is generally supposed to be a kind of Cuscuta.

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Chemical composition.—The seeds weigh on an average one centigram each; they have a bland taste with a peculiar odour, and are difficult to powder. A proximate analysis separated—

Fixed oil and odorous body	3·67
Resin, sugar, and organic acid	4·11
Mucilaginous matter, &c.	21·25
Ash	5·09
Organic residue	44·86

The organic acid gave a dark olive colour with ferric chloride, and was not precipitated from solution by gelatine. The colouring matter was insoluble in ether, alcohol and water, and was removed by diluted caustic soda; it was a fine red, and was entirely precipitated by acetic acid from its alkaline solution. The powdered seeds, burnt with soda-lime, afforded 4·01 per cent. of nitrogen, which is equivalent to 25·38 per cent. of proteids.

ASTRAGALUS SARCOCOLLA, *Dymock.*

Hab.—Persia. The gum.

Vernacular.—Anzerút (*Arab.*), Gújar (*Bom.*, a corruption of the Persian Gúzhad).

History, Uses, &c.—This drug, though still largely used in the East, is hardly known in Europe at the present time. Dioscorides informs us that Sarcocolla is the tear of a Persian tree, that it resembles powdered Frankincense, is of a reddish colour and bitterish taste, has the property of closing wounds and checking discharges from the eyes. It is an ingredient in plasters, and is adulterated with gum.*

Pliny writes to the same effect, and adds that it is valued by painters.† Ibn Sina says that it closes wounds without causing irritation and promotes granulation; used as a plaster it mitigates all kinds of inflammation.

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* Dios. iii., 90. περὶ σαρκοκόλλας.

† Plin. 13, 20; 24, 78.

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Masíh adds that it is cathartic and useful for the expulsion of phlegm and corrupt humours. Haji Zein el Attar says that the Persian name is گوژد (gúzhad), and that the tree which produces it grows in the Shabánkárah hills near Shiraz. Another name for the gum is Jahudáneh. When it first exudes it is white, but from exposure to the sun it becomes red.

Amongst modern writers, Mir Muhammad Husain, the author of the Makhzan-el-Adwiya, informs us that Anzerút is at Ispahan called Kunjud and Agardhak, at Shiraz Kunderú; in Arabic it is known as Kohl-Fársi (Persian collyrium) and Kohl-Kirmáni (Kirman collyrium). The Indians call it Lai. He describes it as the gum of a thorny plant called Shayakah, which is about 6 feet high, has leaves like those of the Frankincense, and is a native of Persia and Turkistan; he then gives a correct description of the drug, and states that it is aperient, and a resolvent of corrupt and phlegmatic humours, &c.; it acts best when combined with such medicines as turpeth, myrobalans, sagapenum, &c. Speaking of particular diseases in which it is employed, he mentions its use in congestive apoplexy combined with castor-oil, and topically in purulent discharges from the eyes;* roasted with onions it is dropped into the ear to cure earache. It is also used internally as an antirheumatic and anthelmintic. The Egyptian women eat it on account of its fattening properties. Dose, ½ to 2 miskáls; large doses are said to prove fatal by obstructing the intestinal glands. With regard to its use in plasters his remarks are to the same purport as those of Ibn Sina. When used as a collyrium he directs it to be prepared by being beaten up in ass's milk, and afterwards dried in an oven until slightly baked.

European writers on Materia Medica briefly notice Sarcocolla. Guibourt remarks that if the statements of the Greeks and Arabians are correct, it cannot be the produce of a Penæa, a genus confined to Africa. He states that Pelletier found it to consist of Sarcocolline 65·30, gum 4·60, gelatinous matter

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* In the Tibb-i Akbari the following receipt is given:—Starch 6 parts, Anzerút and white lead of each 2 parts; sift very fine for an eye-powder.

3·30, woody matter, &c., 26·80. Sarcocolline is described as a substance *sui generis,* soluble in 40 parts of cold water, and 25 parts boiling. A hot saturated solution precipitates on cooling, part of the sarcocolline, which separating as a syrupy liquid, is no longer soluble in water. Alcohol dissolves it in all proportions, the solution mixed with water becomes turbid, but does not precipitate.

Description.—Sarcocolla consists of more or less agglomerated very friable grains; it is opaque or semi-transparent, and varies in colour from deep red to yellowish white or grey; it has hardly any odour and a sharp bitter sweet taste; it swells when heated, and burns with an odour of burnt sugar. Gum Sarcocolla is imported into Bombay from the Persian port of Bushire in bags which contain about 2 cwts.; the total quantity imported must be considerable, as from 12 to 20 bags may often be seen in a single warehouse. The original packages always contain portions of the plant, of which the following is a description :—

FRUIT.—Peduncles short, slender; calyx oblong, bell-shaped, chaffy, ¾ in. long, with a 5-dentate narrow, open mouth, within it are the dry petals, and an oblong, silicious, rostrated pod, as large as a grain of rice in the husk, and having its external surface thickly covered with a felting of white, cotton-like down, consisting of long simple hairs matted together. Although the pod is mature, the petals remain firmly attached, the upper one is hooded and envelopes the rostrum of the pod. The pod is two-valved; attached to its dorsal suture on one side is a single, greyish-brown, vetch-like seed, having a diameter of ⅛ inch; when soaked in water it swells, bursts, and a mass of Sarcocolla protrudes; some of the pods are abortive and are full of the gum.

STEM.—Woody, composed of numerous radiating, wedge-shaped bundles, thorny; thorns ¾ to 1 inch long, and together with the young branches more or less covered with cotton-like down, and encrusted with Sarcocolla.

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No leaves were found, but native authors describe them as similar to those of the Frankincense.

Several handfuls of the fruit may be picked from a bale of gum, but most of it has lost its chaffy calyx from friction. As leaves are never seen, it is probable that the Sarcocolla is collected by beating the bushes after the leaves have fallen. The exudation must be so abundant as to flow on the ground, as masses of sand, glued together by it, of large size, are found in the packages.

Commerce.—The average value of Sarcocolla is Rs. 3 per maund of 37½ lbs. It is rather an important medicinal article in India, as it is one of the principal ingredients of the *lép* (plaster), which the Parsee bone-setters use in combination with cotton to form a support to fractures or sprains, and also to weak joints. The usual composition of *Lép* is Sarcocolla 9 parts, Jadvar 1, Socotrine Aloes 16, Alum 8, Maida-lakri 4, Singapore Dammer 4, Frankincense 7, Ambehalad 7, and Gamboge 12 parts. These ingredients are reduced to a fine powder and then rubbed into a paste with water by means of a stone and muller.*

ASTRAGALUS HERATENSIS, *Bunge.*

Fig.—*Trans. Lin. Soc. 2nd. Ser. Botany. Vol. iii. Pt. I., Plate vi.*

Vernacular—Gabina (*Pers.*). The gum, Katira.

ASTRAGALUS, sp. *aff. A. strobilifero,* Royle.

Hab.—Persia.

Vernacular.—Kon (*Pers.*). The gum, Katira.

History, Uses, &c.—Western Persia has long been known to export to India a gum called *Katira*, similar to the

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* Compare with the malagmata of the Greeks and Romans. Scrib. Comp. 258, *et seq.*

Tragacanth of Western commerce. Tragacanth has been known from a very early period, and Theophrastus and Dioscorides were probably familiar with the plant from which it was obtained, as the latter writer describes it very correctly. The later Greek physicians were all acquainted with the drug, as well as Masih, Ibn Sina, and the other Arabian writers. Haji Zein, A. D. 1368, describes its uses almost in the words of Dioscorides; he calls it Katira, the gum of the tree called Katád; this name the Arabs have converted into Kathirá. According to the Persian Burhán, the Arabic name for the tree is Miswák-el-Abbas. The author of the "Makhzan-el-Adwiya" says that the Persian name of the tree is کون (Kon), a name which Dr. Aitchison found to be current among the peasantry of the Hari-rud valley for the second species placed at the head of this article. Formerly the imports of Tragacanth into India were insignificant, and only sufficient to meet the requirements of a few Persian physicians practising in the country, with whom it is a favourite pectoral, and demulcent in urinary affections. Now, however, it is making its appearance in the Bombay market in large quantities, and of a superior quality to that formerly imported, for the purpose of export to Europe. In modern medicine Tragacanth is chiefly valued for its mechanical property of suspending insoluble powders in mixtures and for giving firmness to lozenges and pill masses.

Secretion.—It has been shown by H. von Mohl and by Wigand that Tragacanth is produced by metamorphosis of the cell membrane, and that it is not simply the dried juice of the plant. The stem of a gum-bearing *Astragalus*, cut transversely, exhibits concentric annual layers which are extremely tough and fibrous, easily tearing lengthwise into thin filaments. These inclose a central column, radiating from which are numerous medullary rays, both of very singular structure, for instead of presenting a thin-walled parenchyme, they appear to the naked eye as a hard translucent gum-like mass, becoming gelatinous in water. Examined microscopically, this gummy substance is seen to consist not of dried mucilage, but

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of the cells of the pith and medullary rays in process of transformation into Tragacanth. The transformed cells, if their transformation has not advanced too far, exhibit the angular form and close packing of parenchyme-cells, but their walls are much thickened, and evidently consist of numerous very thin strata. A similar mode of gum formation from cellulose may be observed in the bark of *Kydia calycina* (*see* p. 228), and a less complete transformation of the same kind in the exudation from the stem of *Bombax malabaricum* (*see* p. 217).

Description.—Tragacanth consists of different layers, either laid one upon another and spirally twisted, or confluent into tear-like masses, or extended into curved, narrow, or broad bands, varying in width between ¼ inch and 1 inch, and sometimes 4 or 5 inches long. These bands are rarely made up of a single layer, but usually are marked with several parallel ridges, indicating the various strata, which are united into broader and thicker laminæ. This form of tragacanth is known as *flake tragacanth* or *leaf gum*, and is the more valuable the whiter and more translucent it is. Smyrna tragacanth is mostly in rather broad and thick flakes, which are yellowish or of a brownish tint, and often prominently ridged. Thin, ribbon-like, and white flakes are produced in Kurdistan and Persia, but are sometimes distinguished in commerce as Syrian tragacanth. Another variety is *vermiform tragacanth*, also called *vermicelli*. It consists of very narrow, variously coiled and contorted string-like pieces, the different coils of which are most frequently confluent. *Common tragacanth*, or *sorts*, in Europe known as *traganton*, is the product obtained by spontaneous exudation, forming sub-globular, conical, or variously shaped tear-like pieces, with the surface rounded and more or less irregular, and usually of a brownish or brown colour, and rather waxy in appearance; but it shows the stratification described above, and, like the white and thin bands, enclose starch.

Tragacanth is hard, tough, difficult to powder, inodorous, and tasteless, insoluble in alcohol and ether, and forms with 50

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parts of water a thick, jelly-like mucilage. When diffused in a much larger quantity of water it forms a ropy liquid which may be passed through a filter, leaving behind an insoluble residue, which in contact with iodine acquires a blue colour from the presence of starch. The mucilage acquires a yellow colour on the addition of caustic soda, and the solution of tragacanth yields clear mixtures with borax, ferric chloride, and sodium silicate, is precipitated by alcohol, thickened by cold lead acetate and subacetate, and precipitated by these salts on heating. (*Flückiger.*)

Chemical composition.—Tragacanth has a specific gravity of 1·38, and contains two gums, one insoluble and the other soluble in water, about 14 per cent. of moisture and 3 per cent., or less, of ash. A reaction for starch is obtained in most samples, and a peculiar red-colouring matter has been observed in some specimens from Persia. The insoluble gum has been named *Bassorin*, $C^{12} H^{20} O^{10}$, an isomer of starch, which forms a sugar when boiled with diluted acid, and mucic acid when heated with nitric acid. The soluble gum affords no precipitate or jelly with alkaline borates, silicates or stannates or ferric chloride, and its solution is rendered turbid by plumbic acetate, and throws up a transparent jelly with alcohol, all of which reactions point to the gum being different to arabin. Giraud considers the insoluble portion of tragacanth to be a pectic compound, and the soluble portion to be a mixture of different bodies, not a definite principle like arabin. Bassorin is an unsaturated compound, whereas arabin and the soluble gums are usually associated with lime or potash The proportion of soluble gum has been variously estimated at from 5·6 to 50 per cent., but these results are attendant upon the employment of small or large quantities of water, and the period of immersion.

In Northern India the seeds of **Astragalus multiceps**, *Wall.*, and **A. tribuloides**, *Delille*, are used on account of their demulcent properties.

LUPINUS ALBUS, *Linn.*

White Lupine (*Eng.*), Lupin blanc (*Fr.*).

Hab.—Egypt, Levant.

Vernacular.—Turmus, Bákila-i-misri (*Arab.*, *Pers.*, *Ind.*).

History, Uses, &c.—This plant has been cultivated since the days of the ancient Egyptians, and is still very extensively sown in Italy, Sicily, and other Mediterranean countries for forage, for ploughing in to enrich the land, and for its round flat seeds, white outside but yellow internally, which when boiled, so as to remove the bitter somewhat deleterious principle, form an important article of food in some districts. It is the θέρμος of the Greeks,* and was much esteemed by the ancients for its medicinal properties. Pliny (22, 74), following the Greeks, informs us that dried lupines stripped of the husk and pounded are applied in a linen cloth to black ulcers, in which they make new flesh: boiled in vinegar they disperse scrofulous sores and imposthumes of the parotid glands. A decoction of them with rue and pepper is given in fever and to expel intestinal worms. He also states that lupines stimulate the appetite and dispel nausea, and that the meal kneaded with vinegar removes pimples and prurigo and allays inflammations. A decoction of them is very good for affections of the spleen, and with honey for retardations of the catamenia: a decoction of the root acts as a diuretic. The Indian Mahometan physicians follow the ancients, but they especially esteem lupines for their supposed pectoral and strengthening properties. In European medicine lupines are no longer used, but the flour was formerly one of the *quatre farines résolutives.* Donnabella (*Practitioner*, xxi., 211, 1877) reported that, having thrown into the rectum about five ounces of a decoction of lupines he soon began to feel general malaise, uneasiness of the head, obscuration of vision, heaviness of the eyelids, vertigo, excitement of mind

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* Throphr. H. P. I, 6, 12; III, 3; VIII, 1, 2, 7, 10, and C. P. III, 4. Dios. II, 101.

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and a sense of constriction of the larynx and pharynx. Several months afterwards he repeated the experiment with the same results. The poisonous principles of lupines, *Ictrogen* and *Lupinotoxin,* are only developed under certain conditions and lose their poisonous properties when heated with water under pressure.

Description.—*L. albus* is an annual plant with palmately 5 to 7-foliate leaves, and obovate-oblong leaflets 1 to 2 inches in length, smooth above and tomentose beneath; the flowers are in terminal racemes on short pedicels, white and rather large; the legume is 3 to 4 inches long, flattish, and contains 3 to 6 depressed globular seeds having a bitter taste.

Chemical composition.—Baumert (*Ann. Agron. April* 25, 1889), who has made a fresh examination of the seeds of the white lupine, found the watery extract to be strongly acid, and to contain malic, oxalic and citric acids. The seeds yielded to ether about 5 per cent. of a golden-yellow oil, free from bitterness, and also a wax soluble in boiling alcohol first noticed by Boyer; these two fatty substances contain phosphorus. Lupines contain no starch or inulin, but a peculiar substance related to dextrine, strongly dextrogyre, and yielding with dilute mineral acids a reducing sugar. This body lately isolated by Steiger is a white hygroscopic powder soluble in water, hardly soluble in alcohol, insoluble in ether; it has been named *galactane,* and may be regarded as a form β of *galactine,* which Müntz obtained from *lucerne.* The seeds also contain another carbo-hydrate discovered by Schulze and Steiger which is insoluble in water, and which when boiled with acids is converted into galactose; it has been named *paragalastine.*

The albuminous portion of the seeds consists chiefly of conglutin with a small proportion of legumin and vegetable albumin. The following table from König's *Nahrungs-mittel* gives the average percentage composition of fourteen samples of yellow lupine seeds:—

Water	12·88
Nitrogenous matter	36·52

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Fat	4·92
Nitrogen free extractive	27·60
Cellulose	14·04
Ash	4·04

In dry substance.

Nitrogen	6·71
Carbo-hydrates	31·68

Three alkaloids have been separated from the different kinds of lupine seed, *luzinine,* $C^{21}H^{40}N^{2}O^{2}$, which is crystallizable, *luzanine* $C^{15}H^{25}N^{2}O$, and *lupulidine,* $C^{8}H^{15}N$, a liquid. According to Paulus and Hiller the total quantity of alkaloids found in different kinds of seed ranges from 0·04 to 0·81 per cent.; yellow lupines contain from 0·65 to 0·81 per cent. of luzinine and lupulidine.

Hayen found in blue lupines only luzanine. Lupine seeds contain only traces of amides or acid amides, none of which have been isolated, but when the seeds are allowed to germinate, a number of these bodies, *viz.,* asparagin, phenyl-amido-propionic acid, amido-valerianic acid, leucine, tyrosin, zanthine, hypozanthine, lecithine, peptone, arginine ($C^{6}H^{14}N^{4}O^{2}$), and choline, make their appearance. Lupinin, $C^{29}H^{32}O^{16}$, the glucoside of lupines, was discovered by Schulze and Barbieri; it crystallizes in fine needles, and dissolves in alkaline solutions communicating to them a yellow colour, with acids it breaks up into lupigenin ($C^{17}H^{12}O^{10}$) and glucose.

MM. Campini and Grimaldi (*Chem. Repert.* 1888, 76,) report that they have isolated *vanillin* from the seeds of *Lupinus albus,* and proved its identity by the crystalline form and by its chemical properties.

Vicia Faba, *Linn.*—The field bean (*Eng.*), Fève des champs (*Fr.*), Bakila (*Pers., Ind.*), is a native of Persia, but now universally cultivated. For an interesting account of the mythology of the bean and its phallic properties, see De Gubernatis. (*Myth. des Plantes ii*, 132—137.) Pliny mentions their use as a food and as a medicine (18, 30; 22, 69).

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The hakíms administer them as a nutritive tonic for rendering the body fruitful (تخصیب البدن), and consider them to be deobstruent and expectorant; the roots are said to be diuretic. The author of the Makhzan, speaking of Bákila, gives κύαμος and several other synonyms for them, and fully describes the various uses to which they are put.

They must not be confounded with the κύαμος ἀιγυπτίος or Coptic bean, the seed of *Nelumbium speciosum.*

Beans are rich in proteids and phosphoric acid, but contain only a small percentage of amylaceous and saccharine matter. The following table showing the percentage composition of beans is taken from König's *Nahrungs-mittel*, and is a summary of the results of 41 analyses of different cultivated varieties of *Vicia Faba* :—

	Maximum.	Minimum.	Mean.
Water	19·70	10·80	14·76
Nitrogenous matter	29·86	17·41	24·27
Fat	2·66	1·12	1·61
Nitrogen free extractive	53·40	44·39	49·01
Cellulose..................	11·30	3·26	7·09
Ash	4·72	1·72	3·26
	In dry substance.		
Nitrogen	5·37	3·27	4·56
Carbo-hydrates	62·65	52·08	57·48

CICER ARIETINUM, *Linn.*

Fig.—*Wight Ic., t.* 20; *Bot. Mag., t.* 2274. Common Chickpea (*Eng.*), Chiche, Tête de belier (*Fr.*).

Hab.—Unknown. Cultivated in warm climates. The seeds and acid exudation.

Vernacular.—Chana (*Hind., Guz.*), Harbara, Chana (*Mar.*), But (*Beng.*), Kadalai (*Tam*), Kadali (*Can.*).

The acid exudation, Chane-ka-sirka (*Hind.*), Chana-amba (*Mar.*), Kadalai-kádi (*Tam.*), Chana-no-kháto (*Guz.*).

History, Uses, &c.—This pulse is the Cicer of the Romans.[*] Plautus[†] and Horace[‡] speak of 'Cicer frictum,' 'parched gram,' which would appear to have been eaten by the poorer classes just as it is in India now. The Italians call it 'Cece.' The plant is cultivated in the south of Europe and also in India, the leaves and stems are covered with glandular hairs containing oxalic acid, which exudes from them in hot weather and hangs in drops, ultimately forming crystals. In India the seeds form one of the favourite pulses of the natives, being eaten raw or cooked in a variety of ways; the flour is also much used as a cosmetic and in cookery. Cicer is the ερεβινθος of Dioscorides. The acid liquid, which is obtained by collecting the dew from the Chanaka plant, is mentioned in Sanskrit works under the name of Chanakámla, and is described as a kind of vinegar having acid and astringent properties, which is useful in dyspepsia, indigestion, and costiveness. Moidín Sheriff gives the following description of its collection:—"In a great many parts of India, where *C. arietinum* is cultivated, a piece of thin and clean cloth is tied to the end of a stick, and the plants are brushed with it early in the morning, so as to absorb the dew, which is then wrung out into a vessel."

Dr. Hové (1787) says:—"On the road (to Dholka) we met with numerous women who gathered the dew of the grain, called by the inhabitants *chana*, by spreading white calico cloths over the plant, which was about 2 feet high, and then drained it out into small hand jars. They told me that in a short period it becomes an acid, which they use instead of vinegar, and that it makes a pleasant beverage in the hot season when mixed with water." Dr. Hové states that the freshly collected fluid tasted like soft water, but that some which he preserved became after some days strongly acid.

According to Dr. Walker (*Bomb. Med. Phys. Trans.*, 1840, p. 67), the fresh plant put into hot water is used by the Portuguese in the Deccan in the treatment of dysmenorrhœa; the patient sits over the steam. He remarks this is only another

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[*] Col., 2, 10; Plin. 22, 72.
[†] Plaut Bac., 4, 5, 7.
[‡] A. P., 249.

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way of steaming with vinegar. Notices of the acid liquid, its uses by the natives, and mode of collection, are given by Dr. Christie (*Madras Lit. Sci. Journ.*, Vol. IV., p. 476); Dr. Heyne (*Tracts*, p. 28); Ainslie (*Mat. Ind.*, Vol. II., p. 56).

Chemical composition.—The fluid collected from the plant consists of water holding in solution oxalic, acetic, and perhaps malic acid, and, according to Dispan, another acid peculiar to the plant. (*Watts' Dict. of Chem. I., p.* 962.) The husked seeds have been examined by Church, who found them to contain:—Water 11·5, Albuminoids 21·7, Starch 59·0, Oil 4·2, Fibre 1·0, Ash 2·6, Phosphoric acid 1·1 per cent. (*Food Grains of India.*) In Lyon's Food Tables, the nitrogen per ounce is given at 14·00 grains. (*Food Tables, Bombay,* 1877.)

The other pulses mentioned by Sanskrit medical writers are:—

Mudga (*Phaseolus Mungo, Linn.*), Mung (*Hind., Beng., Mar., Guz.*), Puchapayaru (*Tam.*), Pessalu (*Tel*). Of this pulse two varieties are distinguished by the Hindus, one green, the other yellow. For medicinal purposes the first is preferred. According to Church, the chemical composition of these pulses with their husks is:—*Green:* Water 10·8, Albuminoids 22·2, Starch 54·1, Oil 2·7, Fibre 5·8, Ash 4·4. *Yellow:* Water 11·4, Albuminoids 23·8, Starch 54·8, Oil 2·0, Fibre 4·2, Ash 3·8, Phosphoric acid about 1 per cent.

Masha (*Phaseolus, Mungo, Linn.* var. *radiatus*) Másh, Urid (*Hind., Beng., Mar., Guz.*), Mimumuli (*Tam.*). *Chemical composition.*—Water 10·1, Albuminoids 22·7, Starch 55·8, Oil 2·2, Fibre 4·8, Ash 4·4, Phosphoric acid 1·1 per cent. (*Church.*)

Mudgaparni (*Phaseolus trilobus, Ait.*), Mugani (*Hind. Beng.*), Muknya, Arkmut (*Mar.*) Nitrogen per oz. 19·78 grains. (*Lyon.*)

Makushtha (*Phaseolus aconitifolius, Jacq.*), Moth (*Hind., Beng.*), Math (*Mar.*) *Chemical composition.*—Water 11·2, Albuminoids 23·8, Starch, 56·6, Oil 0·6, Fibre 4·2, Ash 3·6, Phosphoric acid ·8 per cent. (*Church.*)

Kulattha—(*Dolichos biflorus, Linn.*), Kulthi (*Hind., Beng., Mar.*), Kollu (*Tam.*), Wulawalli (*Tel.*). *Chemical composition with husk*—Water 11·0, Albuminoids 22·5, Starch 56·0, Oil 1·9, Fibre 5·4, Ash 3·2, Phosphoric acid 1·0 per cent. (*Church.*)

Rajamaha. (*Vigna Catiang, Endl.*), Choulai (*Hind., Mar.*), Barbati (*Beng.*), Boberlu (*Tel.*). *Chemical composition, Husked*—Water 12·5, Albuminoids 24·1, Starch 56·8, Oil 1·3, Fibre 1·8, Ash 3·5, Phosphoric acid 1·0. (*Church.*) *With husk*—Water 12·7, Albuminoids 23·1, Starch 55·3, Oil 1·1, Fibre 4·2, Ash 3·6, Phosphoric acid 1·2. (*Church.*)

Masura (*Ervum Lens, Linn.*), Masur (*Hind., Beng., Mar.*), Misurpurpur (*Tam.*), Misurpappu (*Tel.*). *Chemical composition, Husked*—Water 11·8, Albuminoids 25·1, Starch 58·4, Oil 1·3, Fibre 1·2, Ash 2·2, Phosphoric acid ·8 per cent. (*Church.*)

Satila (*Pisum sativum, Linn.*), Matar (*Hind., Beng.*), Watana (*Mar.*). Nitrogen, per oz., 17·09 grains (*Forbes Watson*), about the average of all the pulses.

Adhaki (*Cajanus indicus, Spreng.*), Tur, Arhar (*Hind., Mar.*), Arar (*Beng.*). *Chemical composition, with husk*—Water 13·3, Albuminoids 17·1, Starch 55·7, Oil 2·6, Fibre 7·5, Ash 3·8, Phosphoric acid ·9 per cent. (*Church.*)

Simbi (*Dolichos Lablab, Linn.*) Sim, (*Hind., Beng.*), Walpapri (*Mar.*), Avri (*Guz.*), Alsanda (*Tel.*). *Chemical composition, with husk*—Water 14·6, Albuminoids 20·5, Starch 53·5, Oil 2·2, Fibre 5·8, Ash 3·7. (*Church.*)

Triputi (*Lathyrus sativus, Linn.*), Khesari (*Hind., Beng.*), Lang (*Guz., Mar.*). *Chemical composition*—Water 10·1, Albuminoids 31·9, Starch 53·9, Oil ·9, Ash 3·2. (*Church.*) The toxic principle obtained from this pulse by Astier, was a volatile liquid alkaloid, probably produced by some proteid ferment whose action is destroyed by heat.

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Remarks.—Some of these pulses have several varieties produced by cultivation. Green mudga is considered wholesome and suited to sick persons; a soup of it is often the first article of diet after recovery from acute illness. The following are considered wholesome and suited for use by convalescents: Masura, Kulattha and Makushtha. Masura is considered as highly nutritive and useful in bowel complaints; a poultice of it made with vinegar is an effectual domestic remedy for checking the secretion of milk, and reducing swellings of the mammary glands caused by their distension with milk. Másha and Kulattha are considered to have the latter property. A soup made with Kulattha is prescribed as an antilithic. Másha is much used in medicine, internally and externally, in paralysis, rheumatism and nervous affections; but it is always combined, with other drugs, such as asafœtida, Ricinus root, Mucuna Sida, &c. (*Dutt.*) Mash, Kalie and Masur are not allowed to be eaten by Hindu widows, as these varieties are supposed to be too stimulating.

Lathyrus sativus, as article of diet, has long been known to be capable of producing toxic symptoms when used for a prolonged period either by animals or human beings. In one district in Bengal, nearly four per cent. of the population were sufferers from it in 1860. (*Irving, Indian Ann. of Med. Sci., vii.*, 127; *Kirk, ibid.*, 145.) This condition, known as *lathyrismus*, has been investigated by Dr. B. Suchard. The chief effect produced on the human subject is upon the muscles of the lower extremities, especially on those below the knee. In horses also paralysis of the hinder extremities takes place, and death has followed from bilateral paralysis of the laryngeal recurrent nerves and consequent asphyxia. The laryngeal affection has not, however, been observed in the human subject. Cantarri of Naples has recorded a number of cases in which he has carefully examined the muscles, and has found that the adductors are less effected than the abductors. The muscle of the face, neck, and trunk were not affected. Cutaneous sensibility is not always affected, even in the legs; reflex action is unaffected. The descending galvanic current produces slight contractions, but only when the current is closed. These contractions are weaker on the right side than on the left, and weaker in the flexors than in the extensors; with the ascending current no contractions are obtained, whether the current is open or closed. Examined under the microscope the affected muscles showed a diminution in the number of transverse striæ, and little globules of oil were observed. The *post-mortem* examinations failed to show any lesion of the spinal cord.

Teramnus labialis.—*Spreng.*, *Wight, Ic. t.* 168. This wild pulse is called in Sanskrit Másha-parni, "having leaves like Másha" (*Phaseolus Roxburghii*), Haya-puchchha "horse's tail," and Svayambhu, "self-existing." It is described in the Nighantas as cooling, pungent, dry, strengthening, sweet, astringent, digestive and febrifuge. In the vernaculars it bears the following names:—Máshparni (*Hind.*), Masháni (*Beng.*), Adavi-vuddulu (*Tel.*), Káttu-alandu (*Tam.*), Káda-uddhu (*Can.*), Rán-udid (*Mar.*). Like Másha it is much used in medicine both internally and externally in paralysis, rheumatism and affections of the nervous system. (*See Másha.*)

GLYCYRRHIZA GLABRA, *Linn.*

Fig.—*Bentl. and Trim.*, *t.* 74. Liquorice (*Eng.*), Réglisse (*Fr.*).

Hab.—Europe, Northern Asia. The root and extract.

Vernacular.—Jethi-madh, Mulatthi, Mithi-lakri (*Hind.*), Jethi-madh (*Guz.*), Jeshti-madh (*Mar.*), Ati-maduram (*Tam.*), Yashti-madhukam (*Tel.*), Yashti-madhuka (*Can.*), Jaishto-modhu (*Beng.*).

History, Uses, &c.—Liquorice grows wild in Arabia, Persia, Turkistan and Afghanistan, and has been introduced into the Punjab and Sind. Kinneir observed it growing abundantly near Basra, and Aitchison found it growing abundantly all over the Badghis and throughout the Harirud and Khorasan districts. In Persia glass-bottle-makers use the wood for melting their materials, as they say it gives a greater heat than any other kind of fuel. The root, in Sanskrit called Yashtimadhu and Madhuka, must have been known to the Hindus from a very early date, as it is mentioned by Susruta. Hindu works describe it as demulcent, cooling and useful in cough, hoarseness, &c. It is also recommended as a flavouring agent, and enters into the composition of many external cooling applications.

Abu Hanifeh describes *Sus* as a well-known plant, the expressed juice of which is an ingredient in medicine. He says the roots are sweet and the branches bitter. El Mutarrizi in the Mughrib states that the leaves are put into the beverage called *nabid* to make it strong. The modern Arabs call the root Irk-es-sus, and make a strong infusion of it which they drink. The dried juice is called Rab-es-sus; it is made by the Arabs, Turkomans, and Persians at Yezd. In Persia the liquorice plant is called Mehak and Mazhu.

The author of the *Makhzan-el-Adwiya* gives a lengthy description of the plant, and directs the root to be decorticated before it is used. He says that the Egyptian is the best, next that of Irak, and then Syrian. The root is considered hot, dry and suppurative, demulcent and lenitive, relieving thirst and cough, and removing unhealthy humours, also diuretic and emmenagogue, useful in asthma and irritable conditions of the bronchial passages. Ibn Sina recommends the decoction in cold colic; it is also dropped into the eyes to strengthen the sight.* A poultice made of the leaves is said to be a cure for scald head, and stinking of the feet or arm pits. Muhammad bin Ahmad and Yohānna bin Serapion recommend the seeds as being the most active part of the plant.

For an account of the history and cultivation of liquorice in Europe, the *Pharmacographia* may be consulted.

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* Conf. Dios. *περί γλυκύῤῥιζης* iii., 5; and Plin. 22, 11; Celsus 5, 23, calls it Dulcis radix.

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Description.—Liquorice root varies much in size, the largest pieces being 2 inches or more in diameter, and about 4 or 5 inches long, with the bark on; the wood is of a bright yellow colour, tough and fibrous. The taste is sweet at first, afterwards a little bitter. The root is heavy and sinks in water.

Microscopic structure.—Commencing from the exterior the bark shows from 8 to 10 rows of closely packed brown tabular cells, then a cellular zone loaded with starch, next we meet with the expanded ends of the medullary rays, which gradually become narrower towards the woody part of the root, between them are pyramidal bundles made up of a parenchyme consisting of transverse cells and small bundles of liber cells with thick walls. The wood is traversed by large medullary rays continuous with and having the same structure as those in the bark. The woody columns are made up of large fenestrated vessels and bundles of wood cells, between which portions of parenchyme continuous with that of the medullary rays here and there intrude.

Chemical composition.—According to Flückiger and Hanbury (*Pharmacographia*, p. 158), liquorice root contains in addition to sugar and albuminous matter, a peculiar sweet substance named glycyrrhizin, which is precipitated from a strong decoction upon addition of an acid or solution of cream of tartar, or neutral, or basic acetate of lead. When washed with dilute alcohol and dried, it is an amorphous yellow powder, having a strong bitter-sweet taste and an acid reaction. It forms with hot water a solution which gelatinizes on cooling, does not reduce alkaline tartrate of copper, is not fermentable, and does not rotate the plane of polarization. From the analysis and experiments of Gorup-Besanez (1861), it appears that the most probable formula of glycyrrhizin is $C^{24}H^{36}O^{9}$. By boiling glycyrrhizin with dilute hydrochloric acid, it is resolved into a resinous amorphous bitter substance named glycyrretin, and an uncrystallizable sugar having the characters of glucose. The formula of glycyrretin has not yet been

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settled. Alkalies easily dissolve glycyrrhizin with a brown colour and emission of a peculiar odour. In the root it perhaps exists combined with ammonia, inasmuch as the aqueous extract evolves that alkali when warmed with potash. The sugar of liquorice root has not yet been isolated. Asparagin and malic acid have been obtained from it. The outer bark contains a small quantity of tannin.

The sweet taste of the roots is probably owing to the glucoside combined with ammonia. Habermann found that glycyrrhizin-ammonia was the acid ammonium salt of a nitrogenous body, glycyrrhizic acid, and this acid he considers to be the active principle of liquorice. It forms a jelly-like mixture with 100 parts of water, and is insoluble in ether and slightly soluble in alcohol. Glycyrrhizic acid breaks up on boiling with dilute sulphuric acid into glycyrrhetin and parasaccharic acid. (*Ann. Chem und Pharm.*, 197, p. 105.)

Commerce.—The Indian market is supplied from Persia, the Punjab and Sind. The kind known as Karachí liquorice is the best, and fetches from Rs. 50 to 80 per kandy of 5 cwts. Persian liquorice is smaller, and not so sweet.

ARACHIS HYPOGÆA, *Linn.*

Fig.—*Bentl. and Trim., t.* 75. Ground-nut, Peanut, Monkey nut (*Eng.*), Pistache de terre (*Fr.*).

Hab.—Africa, cultivated in India. The seeds and oil.

Vernacular.—Beláti-mung, Chini-bádám (*Hind., Beng.*), Bhuisingh (*Mar.*), Verk-kadalai, Nilak-kadalai (*Tam.*), Verushanaga-kaya (*Tel.*), Nelagale-kayi, Nelakadali (*Can.*), Bhuichana (*Guz.*).

History, Uses, &c.—The ground-nut, a native of Africa, is not mentioned in Hindu or Mahometan works on Materia Medica, nor does it appear to be used in India by the natives for any medicinal purpose. The seeds, however, are eaten like nuts and are pressed for their oil. As far as we

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can gather, the ground-nut does not appear to have been cultivated extensively in India for more than about fifty years. It was probably introduced into Bengal from China, as it was first known in that part of the country as Chini-bádám (Chinese almond). In Western India it was most likely introduced from Africa, or possibly by the Portuguese from Brazil, and was no doubt used only as an article of diet for a considerable time, just as the seeds of a closely allied plant (*Voandzeia subterranea*) imported from Mozambique are at present eaten in Goa and Bombay under the name of Mosambi-chana (Mozambique gram). The value of the ground-nut as an oil seed was first recognised in Europe about 1840, since which date its cultivation has been greatly extended. At the present time the seeds and oil are largely exported to Europe, where the latter is much used for soap-making. In Bombay the oil is expressed at the Government Medical Store Depôt for pharmaceutical purposes to the extent of about 6,000 lbs. annually. It is used as a substitute for olive oil. For making plasters the mixed sweet oil of the bazar may be used, but it requires rather more oxide of lead than ground-nut oil, the latter in the proportion of 90 lbs. of oil to 41 lbs. of oxide makes an excellent plaster of a very pale colour and perfect consistence. Ninety pounds of bazar oil require 43 lbs. of oxide.

Description.—Cold drawn ground-nut oil is of a pale yellow colour, and has an agreeable nutty odour and bland taste; it is a non-drying oil, the yield from the nuts being about 38 to 45 per cent. The specific gravity of the fresh oil is ·918 at 15° C. and of the old ·920. At 3° C. it becomes turbid, at 3° to 4° it concretes, and hardens at —7°. If kept long it becomes rancid. (*Brannt.*)

Chemical composition.—In Arachis oil, the commoner glycerides, palmatin and olein are partially replaced by the homologous glycerides of hypogæic and arachidic acids. (*Allen.*) A glyceryl ether of Arachic acid also occurs in the tallow of *Nephelium lappaceum.* (*Oudeman.*)

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Kreiling, besides separating arachic acid, obtained another acid which he identifies with lignocerinic acid, $C^{24}H^{48}O^{2}$, discovered by Hell and Hermann in 1880 in beechwood tar. (*Ber.* xxi., 880.) The seeds, according to Corenwinder, contain in 100 parts 6·76 water, 51·75 oil, 21·80 nitrogenous substances, 17·66 starch with some nitrogenous matter, 2·03 phosphoric acid, potash, magnesia and chlorine. (*Jour. de Phar. et de Chim.* 1875., XVIII.)

Commerce.—The plant is cultivated in many parts of Western and Southern India. The fluctuations in the quantity exported and in the price of the seeds indicate that the crop is an uncertain one and liable to partial failure from the attacks of insects or from an insufficient rainy season. In the Bombay market the price of the seeds ranges from Rs. 25 to Rs. 30 per kandy (5 cwts.) according as the supply is abundant or otherwise. There are two varieties, a light-coloured seed which is perferred for eating but does not yield much oil, and a reddish seed which yields much oil. During late years there has been a rapid increase in the quantity of ground-nuts exported from Bombay to Europe; in 1879-80, the exports were valued at two lakhs of Rupees, in 1880-81 eight and one quarter lakhs, in 1881-82 sixteen lakhs, of which latter quantity France alone took 12⅓ lakhs, of the remainder Belgium took 2 lakhs worth, Germany Rs. 2,760, Holland Rs. 17,633, Italy Rs. 6,000, and England Rs. 1,381. In 1885-86, India exported 33,000 tons valued at 33 lakhs of rupees; in 1886-87, 47,000 tons valued at 42 lakhs; in 1887-88, 63,000 tons valued at 61 lakhs.

CÆSALPINIA BONDUCELLA, *Fleming.*

Fig.—*Gärt. Fruct. ii., t.* 148; *Bentl. and Trim., t.* 85. Nicker tree, Bonduc nut (*Eng.*), Yeux de bourrique (*Fr.*).

Hab.—India. The seeds.

Vernacular.—Katkaranj, Katkaleja, Ságarghola (*Hind.*), Kazhar-shikkay, Gech-chakkay (*Tam.*), Gach-chakaya (*Tel.*), Gajaga-kayi (*Can.*), Jhagra-gula, Náta (*Beng.*), Kákachia, Gajga (*Guz.*), Gajri, Gajar-ghota (*Mar.*).

History, Uses, &c.—This plant, called in Sanskrit Pútikaranja, in Arabic Akitmakit, and bearing in Persia the vulgar name of Kháya-i-Iblis (Devil's testicles), has long been well known both to the Hindus and Mahometans as having medicinal properties; it appears to be found near the coast in all hot countries, its extensive distribution being caused by the transportation of its seeds from one country to another by means of oceanic currents. Ibn Sína says that its medicinal properties resemble those of the Peony. Clusius has a figure of the pods under the name of Lobus ἐχινώδης. Rumphius, who calls it *Frutex globulorum*, says that the seeds are vermifuge, and the leaves, roots and seeds emmenagogue, deobstruent and febrifuge. In Persia and India the seeds are considered to be hot and dry, useful for dispersing swellings, restraining hæmorrhage, and keeping off infectious diseases. Half a seed rubbed up with several cloves is said to relieve the pain of colic, and with long pepper to be a valuable remedy for malarious fevers. The seeds roasted and powdered are administered for hydrocele internally, and at the same time applied externally, spread upon castor-oil leaves. They are also given internally in leprosy, and are thought to be anthelmintic. The oil in which they have been boiled for a long time is applied to wounds to promote cicatrization. The oil expressed from the seeds is used as a cosmetic; it is said to soften the skin and remove pimples, &c. Necklaces of the seeds strung upon red silk are worn by pregnant women as a charm to prevent abortion, and are hung upon trees to prevent their fruit falling off. Ainslie notices the use of the seeds in conjunction with spice as a tonic by native practitioners, also their use as an external application to hydrocele. He besides draws attention to the root and leaves as having similar properties. In the Concan the juice of the leaves with yellow zedoary and *Butea frondosa* seeds is given to children for intestinal worms. Four tolás of the juice is given as an antiperiodic in fever, and

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the seeds with gúr (molasses) in hysteria. In 1868 the seeds were made official in the *Pharmacopœia of India* as a tonic and antiperiodic, and in the compound powder (also official) the native form of administration with black pepper has been adopted. From the notes at the end of the *Pharmacopœia* it will be seen that the general tenor of the reports from medical officers in India is in favour of the antiperiodic and tonic effects of the remedy. The seeds are always kept in the druggists' shops, and are much used by native practitioners in the various ways above described. In Gambia, where they are called "Coorie seeds," the expressed oil is used for ear discharges, and a decoction of the roasted seed for consumption or asthma. The specific name of the plant is derived from the word Bunduk, an Arabic form of the Persian Finduk. The Arabs also call the seeds Hajar-el-ukáb, or "eagle stones."

Description.—The seeds are nearly globular, ½ to ¾ of an inch in diameter. They are of a dull grey colour, smooth, very hard: the umbilicus is surrounded by a small, dark brown, semilunar blotch opposite the micropyle; the shell is very thick, and contains a white kernel, which consists of two cotyledons and a thick radicle having a very bitter taste. The bark and wood of the root are hardly at all bitter. A microscopic examination shows the presence in the cotyledons of mucilage, starch, oil, and albumen. The cells of the testa are blackened by perchloride of iron, showing the presence of tannin.

Chemical composition.—The authors of the *Pharmacographia* isolated a non-alkaloidal bitter principle from the kernels. Recently (1886), MM. Ed. Heckel and Fr. Schlagdenhauffen found the cotyledons of the seeds to contain oil 25·130, bitter principle (resin?) 1·925, sugar 6·830, salts 3·791, albuminoid matter, soluble and insoluble, 20·490, starch 35·697, water 5·800, loss 0·327, per cent. The bitter principle of the Bonduc-nut is a white, bitter powder, without acridity; it is entirely soluble in alcohol, acetone, chloroform and glacial acetic acid; very little soluble in ether and bisulphide of carbon, almost insoluble in petroleum ether and water. It is dissolved by essential and fatty oils, whence the bitterness of the oil extracted from the seeds by petroleum ether, a bitterness which can be removed by treating the oil with alcohol. The best method of preparing the bitter principle is to pour the chloroform solution into petroleum ether, or to precipitate with water a solution in glacial acetic acid. Alkalies have hardly any effect upon the bitter principle, ammonia dissolves a trace at the temperature of the water bath, caustic potash does not saponify it. Submitted to the action of heat it swells up and melts at 145° C., and then slowly decomposes; with hydrochloric acid it at first strikes a dark colour, then slowly dissolves, forming a rose-coloured solution. With nitric acid it is darkened, and finally separates into a number of red resinous drops; with sulphuric acid it forms a dark brown solution, which after half an hour becomes deep red; the red colour is much more marked when a trace of ferric chloride is added to the acid. The pure bitter principle yielded Messrs. Heckel and Schlagdenhauffen C 62·60, H 7·75, O 29·65 per cent., from which the formula $C^{14}H^{15}O^{5}$ is deduced. Clinical experiments made with this bitter principle by Dr. Isnard, Chief Medical Officer of the Customs Department, Marseilles, led him to the conclusion that in doses of from 10 to 20 centigrams it is as efficient a remedy in ordinary intermittents as quinine salts. (*Journ. de Phar. et de Chim., Aug. 1st,* 1886.) According to Brannt, the oil from the seeds is used as an embrocation in rheumatism.

Commerce.—The seeds are collected on the coast and sold to the druggists. Value, Rs. 12 per cwt.

Cæsalpinia digyna, *Rottl.*, a shrub of the E Himalayas, E. and W. Peninsulas and Ceylon, is used in native practice. The root (*Vâkeri-mul*) is astringent. It is given internally in 6 massa doses mixed with milk, ghi, cummin and sugar, in phthisis and scrofulous affections; when sores exist it is applied externally as well; a kind of tuberous swelling which is found on the root is preferred.

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CÆSALPINIA SAPPAN, *Linn.*

Fig.—*Roxb. Cor. Pl. i.* 17, *t.* 16. The wood. Sappan wood (*Eng.*), Sappan (*Fr.*).

Hab.—E. and W. Peninsulas, Pegu.

Vernacular.—Patang (*Hind., Mar.*), Vattangi, Vattekku, Vartangi (*Tam.*), Bokom (*Beng.*), Okánu-katta, Patanga-katta, Bukkapu-chekka (*Tel.*), Patanga-chekke (*Can.*), Patang (*Guz.*).

History, Uses, &c.—Sappanwood, in Sanskrit Pattanga and in Arabic and Persian Bakam, is by some Sanskrit authors included among the different kinds of Sandalwood in the same manner as the wood of *Pterocarpus Santalinus.* (*Vide P. Santalinus.*) It is cultivated in the Madras Presidency. When a daughter is born in a Thean family, the father plants a certain number of Sappan trees which form her dowry when married. Sappan wood is not generally used as a medicine either by Hindus or Mahometans, although it is described in their books as being of use to heal wounds and stop hæmorrhage from the lungs. Ainslie, however, says that the Vytians consider a decoction of the wood as a powerful emmenagogue, and remarks that the Cochin-Chinese hold the same opinion. In the *Bengal Dispensatory*, and more recently in the *Pharmacopœia of India*, it is recommended as a substitute for Logwood. At the Bombay Government Medical Depôt it has been used instead of Logwood for some years. Patang is used as a dye, and a very large quantity is consumed in the preparation of Gulál, the red powder which the Hindus cover themselves with at the time of the Holi festival. This powder is made by exhausting the wood with water, the liquid extract is then poured upon Tavákir (arrowroot of *Curcuma angustifolia*) and well mixed by treading it with the feet, alum is then added, and the mixture dried and powdered. Some makers also add a little carbonate of soda. Cheap aniline reds are however often now used instead.

Description.—The wood is solid, heavy, hard and close-grained, whitish when freshly cut, but becoming red from exposure to the air. It has no particular taste or smell, but is astringent, and communicates a fine red colour to water and alcohol.

Chemical composition.—The colouring matter of Sappanwood appears from Bolley's investigations to be identical with Chevreul's brazillin obtained from brazilwood. Pure sappan red or brazillin, $C^{16}H^{14}O^{5}$, crystallizes from absolute alcohol in colourless rhombohedrons, or in short monoclinic prisms containing 67·11 per cent. of carbon, 5·43 hydrogen, and 27·46 oxygen; from hydrated alcohol or from aldehyde, in monoclinic needles, containing $2\,C^{16}H^{14}O^{5}3H^{2}O$, turning brown at 90° and giving off 6·61 per cent. of water; and no more at 120°. Brazillin resembles hematoxylin, and like it is soluble in ether, alcohol, and water. Alkalies produce a carmine-red coloration, which disappears when the liquid is warmed with zinc dust, but returns on exposure to the air. On boiling with peroxide of lead and water a strong fluorescence is developed. By oxidation brazilein is produced.

Commerce.—Two qualities are found in the market—*viz.*, Singapuri and Dhunsari, of about the same value, Rs. 42 per kandy of 7 cwts. A third quality from Ceylon is only valued at Rs. 30 per kandy.

The imports into Bombay in 1881-82 were 1887 cwts., valued at Rs. 11,816.

GOA POWDER.

Mr. D. S. Kemp (*Pharm. Journ.* (2), V., 345,) was the first to draw attention to this substance in 1864 as a secret remedy used by the native Christians of Portuguese India for a disease of the skin called *Gajkaran* in Marathi. It was then only occasionally offered for sale in Bombay at Rs. 12 to 30 for a tin containing 1 lb., and was known as *Ringworm Powder, Goa Powder*, or *Brazil Powder.* The exact date of its first introduction into India is not known, but like many other products of the New World, it was probably introduced by the

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Jesuits towards the latter part of the 18th century. Kemp made an examination of it, and came to the conclusion that it contained principles similar to those described by Pelouze and Fremy as existing in Orchella weed. Attfield in 1875 (*Pharm. Journ.* (3), V., 721,) made a more complete examination, and obtained a substance (chrysarobin), which he supposed to be chiefly chrysophanic acid. In the same year Dr. J. F. Da Silva Lima of Brazil (*Med. Times and Gazette, Mar. 6th,*) suggested that the substance known as Goa Powder in India was probably identical with the Araroba or Arariba (tawny-coloured powder) of the natives of Brazil, called by the Portuguese *Po'de Bahia*, or Bahia powder, from its being obtained from that province. Dr. Da Silva Lima also stated that it was the produce of a leguminous tree, and had long been in use in the Brazils as a remedy for Herpes circinatus, chloasma and intertrigo. Shortly before this, Dr. Fayrer of Calcutta (*Med. Times and Gazette, Oct. 24th,* 1874,) had drawn the attention of the Medical profession to the value of Goa Powder made into a paste with vinegar or limejuice as a remedy for the skin diseases already mentioned, and his article appears to have attracted Dr. Da Silva Lima's attention to the subject. Mr. E. M. Holmes (*Pharm. Jour.* (3), V., 801,) stated that the wood found in Goa Powder was very similar to that of *Cæsalpinia echinata*, Lam., but J. L. Macmillan pointed out that this wood yields its colouring matter to water, while Araroba does not. In 1878, C. Liebermann and P. Seidler (*Pharm. Journ.* (3), IX., 896,) showed chrysarobin to be mainly a hitherto unknown compound, $C^{30}H^{26}O^{7}$, for which they retained the name proposed by Attfield.

The botanical source of Araroba was determined in 1879 (*Pharm. Journ.* (3), X., 42,) to be *Andira Araroba*, Aguiar, a large tree common in the damp forests of Bahia, where it is known as *Angelim amargoso.* The Araroba is contained in the large porous vessels and in clefts or cavities which traverse the wood in direction of the diameter, and are prolonged through the entire trunk; it is obtained by cutting down the tree, splitting the trunk, and scraping the powder from the clefts, and is seen in commerce as a rough powder, or in small irregular pieces, originally of a light yellow colour, but usually darkened by exposure to light and moisture to a dull-ochrey, pale-brown, or even umber-brown or dark-purple colour. It has a bitter taste. (*Cf. Pharm. Journ.* (3), X., 814.)

Respecting the medicinal uses of Goa Powder, Sir J. Fayrer remarks:—"Europeans when in India, and occasionally after their return to Europe, are liable to certain troublesome eruptions on the skin of the trunk and extremities, which becoming chronic, are not only the source of considerable annoyance, but often somewhat tedious in yielding to treatment.

"One variety of the eruptions I refer to—commonly described as ringworm—assumes the form of reddish slightly raised spots, which rapidly spread as rings, encircling patches of sound skin, varying in size from a split-pea to that of a shilling, or even larger, with a slightly furfuraceous desquamation, and giving rise to much irritation and itching. They sometimes remain few and far between, but are apt to spread over all parts of the body or limbs.

"This eruption is due either to herpes or tinea circinatus, but probably, in many cases, to a combination of both of these; the initiatory patch of furfuraceous herpes becoming a congenial nidus for the subsequent development of the trichophyton of the tinea.

"Such, I would suggest, is the pathology of the eruption generally seen and spoken of as ringworm in India, though it is probable that other forms of eruptions, such as lichen circumscriptus, erythema, and psoriasis guttata, are at times included under the same designation. Another form of eruption to which I would allude is probably rather to be referred to chloasma. It affects the groins, the inner sides of the thighs, and those delicate surfaces of the integument that are prone to be the seat of moisture as well as other parts of the integument. It generally makes its appearance, and is most troublesome, during the hot and damp seasons. It is also

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occasionally associated with tinea, which appears on its margin, or separately on other parts of the body.

"The remedy that I have found to be most certainly and rapidly effective is the solution in common vinegar or lemon-juice of Goa Powder. This rarely fails to effect complete removal of the disease after two or three applications repeated daily.

"The mode of application is to dissolve a few grains of the powder in common vinegar or lemon-juice to about the consistence of cream, and then paint the solution over the eruption and for a little distance beyond its margin on to the sound skin. It causes no pain at first, but in the course of a few hours there is a sensation of a dull heavy nature, as though the skin had been bruised, the eruption becoming white, whilst the surrounding skin is stained of a dark colour. The sense of uneasiness, however, soon passes away, and the integument resumes its natural characters; all traces of the disease disappear at the same time. Should any vestige of the eruption remain, or any indications of its return appear, a fresh application should be made. In a few days the dark discoloration of the skin begins to fade, gradually merging into the normal tint. At the same time a change takes place in the eruption, which gradually regains the natural colour of the skin; and by the time that the discoloration caused by the powder has disappeared, that of the eruption has also passed away, and the patient is well. Of course, it cannot be expected that these favourable results will always follow immediately. In chronic cases there is more obstinacy, and several repetitions of the application may be needed; but in recent examples the result will be generally favourable.

Chemical composition.—Chrysarobin is present in Goa powder to the extent of about 70 per cent., and when pure is a pale-yellow powder, consisting of small wart-like crystals made up of leaflets and acquiring on exposure a darker tint. By repeated crystallization from glacial acetic acid it is obtained pure in the form of small yellow scales, which are fusible and partly sublimable, nearly insoluble in water and ammonia,

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sparingly soluble in alcohol, more freely soluble in amylic alcohol, ether, collodion, chloroform, and various hydrocarbons. It is inodorous, and, on account of its insolubility in water, tasteless. Chrysarobin dissolves in concentrated sulphuric acid with a yellow colour, is nearly insoluble in very diluted potassa solution, and yields with melted potassa a brown mass. Chrysophanic acid, on the other hand, dissolves in concentrated sulphuric acid and in very dilute potassa solution with a red colour, and on evaporation to dryness of a solution in alkali a violet or blue colour is produced. The solution of chrysarobin in strong potassa solution has a yellow colour and a strong green fluorescence, and on being agitated with air rapidly acquires a red colour, through the formation of chrysophanic acid; $C^{30}H^{26}O^{7}$ (chrysarobin) $+$ $2O^{2}$ yields $2C^{15}H^{10}O^{4}$ (chrysophanic acid) $+$ $3H^{2}O$.

Tests.—If boiled with 2000 parts of water, chrysarobin should not be completely dissolved; the filtrate should be pale reddish-brown, tasteless, neutral to test-paper, and should not be coloured by ferric chloride. Chrysarobin should be almost wholly soluble in 150 parts of hot alcohol. If a minute fragment of chrysarobin be added to a drop of fuming nitric acid, the red solution extended to a thin layer, and a little ammonia added a violet colour should be produced.—*P. G.* (*Stillé and Maisch.*) According to Allen, the *Chrysophanic acid* of commerce is an indefinite mixture of the acid and chrysarobin. It is stated to be liable to adulteration with picric acid and other yellow colouring matters.

Commerce.—Araroba is now very largely imported into India, and is sold under the names of Chrysarobine, Ararobine, and Goa Powder. Messrs. Kemp & Co. inform us that they import about a ton annually.

CÆSALPINIA PULCHERRIMA, *Swartz.*

Fig.—*Bot. Mag. t.* 995; *Rheede, Hort. Mal. vi.*, t. 1. Small Gold Mohar (*Eng.*), Fleur de paon, Haie fleurie (*Fr.*).

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Hab.—Uncertain. Cultivated in India. *Syn.*—Poinciana pulcherrima.

Vernacular.—Gul-i-turah, Krishna-chura (*Hind.*, *Beng.*), Shankeshvar (*Mar.*), Mail-Kannai, Komri (*Tam.*), Kenjige (*Can.*).

History, Uses, &c.—This elegant shrub, named after M. de Poinci, once Governor of the Antilles, has become quite naturalized in India, and is one of the commonest of garden shrubs. According to Ainslie it was introduced into the Botanical Gardens in Calcutta in 1792. He gives the following description of it:—"The species in question is a most beautiful tree, which commonly rises to about 12 to 14 feet high, with leaves doubly pinnate, and leaflets oblong-oval, emarginate; they and the calices smooth; corymbs simple; petals fringed; stamens very long. It would appear to be a native of both the Indies; it is the Hoa-phung of the Cochin-Chinese; on the Malabar Coast it is called Tsietti-mandáru; in Ceylon, its common name is Monora-mal; and from its extreme beauty, Burmann gave it the appellation of 'Crista pavonis flore elegantissimo variegato.' The French in the West Indies call it 'Fleur de paradis.' The flowers come out in loose spikes at the extremity of the branches, the petals which have an agreeable odour, are beautifully variegated with a deep red or orange colour, yellow, and some spots of green." All parts of the plant are said to be emmenagogue and purgative, but there appears to be no record of any exact observations upon this point.

Description.—The bark is ash-coloured, smooth, thickly studded with small elliptic corky warts, the whole of the suber readily separates like birch bark, disclosing a streaky, mottled, green and pink surface, which is marked by numerous small scars corresponding to the warts above mentioned; the substance and internal surface of the bark is of a pinkish tinge. Taste rather nauseous, very astringent, microscopic structure not in any way peculiar, parenchyme loaded with starch, many cells contain red colouring matter.

POINCIANA ELATA, *Linn.*

Fig.—*Bedd. Fl. Syl.* 178.

Hab.—Western Pennisula. Cultivated elsewhere.

Vernacular.—Sandesra (*Guz.*), Vada-narayanan (*Tam.*).

Description.—An erect tree, 20—30 feet high. Leaves ½—¾ ft. long; pinnæ 10—16; leaflets 30—40, membranous, caducous, close, sessile, obtuse, ligulate. Flowers in corymbose racemes; pedicels obovoid; buds finely grey-downy; calyx very coriaceous, ¾—1 inch long, petals scarcely exserted, an inch broad, shortly clawed. Filaments bright red, 3—4 times the length of the calyx, downy near the base; pod 6—8 inches long by above an inch broad, 4—8 seeded. (*Flora Br. Ind.*) Much cultivated in Guzerat. The natives consider the leaves to be of a very hot nature and good for rheumatism and flatulence; they are much used by women after confinement, the dose being 3 tolas of the juice with 3 tolas of ghi every morning, and strict diet for 15 days. There is a superstition that the touch of the root removes the pain of a scorpion sting. The gum is dark-coloured and mucilaginous, but unimportant.

SARACA INDICA, *Linn.*

Fig.—*Bedd. Fl. Syl., t.* 57; *Burm. Fl. Ind.*, 85, *t.* 25, *f.* 2; *Wight Ic.*, t. 206; *Bot. Mag.*, 3018. The Asoka tree (*Eng.*), Jouésia Asjogam (*Fr.*).

Hab.—Himalaya to Ceylon. The bark.

Vernacular.—Asok (*Hind.*, *Beng.*), Ashoka (*Mar.*), Asupála (*Guz.*), Ashogam (*Tam.*), Asoka (*Can.*).

History, Uses, &c.—This tree is covered with cymes of rich orange-coloured flowers in March and April which gradually turn red. In the fourth act of the Mricchakatika it is likened to a blood-stained warrior. Asoka is famed in Hindu

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mythology from the circumstance of Sita, the wife of Rámchandra, having been protected from the caresses of the monster Rávana by a grove of the trees. It is the anthropogonic tree of the Vaisya caste, and a branch from it is brought to the house during their marriage ceremonies. In the Bhavaprakasha it is called Ganda-pushpa, or odorous flower; another name is Anganapriya, "dear to women." The tree is the emblem of love, and was burnt by the penitent Siva along with Kámadeva, the god of love, who wished to seduce him (*Kumárasambhava*, iii. 26); it is said to blossom when touched by the foot of a beautiful woman. (*Kálidasa.*) The name Ashoka signifies "free from pain;" in the Bhavaprakasha vermifuge properties are attributed to it, and in the Rajanighantu it is called Krimikaraka. At the Ashok-ashtami, or eighth day of the light fortnight of the month Chait (April-May), a festival in honour of Vishnu is observed in most parts of India, when part of the ceremonial consists in drinking water with the buds of the Asoka in it. The bark is much used by Hindu physicians in uterine affections, and especially in menorrhagia. Chakradatta directs a decoction of the bark in milk to be made by boiling eight tolas of it with eight tolas of milk and thirty-two tolas of water till the latter has evaporated. This quantity is given in two or three doses during the course of the day in menorrhagia. (*Dutt, Hind. Mat. Med., p.* 143.) Its properties appear to be purely astringent.

Description.—The bark is externally greyish-brown and scabrous; its substance white when freshly cut from the tree, but turning rapidly red after exposure to the air. The taste is mildly astringent and acidulous.

Chemical composition.—A decoction gave a greenish precipitate with ferric chloride, and a brownish sediment with solution of iodine in potassium iodide. It contained 10·3 per cent. of aqueous extract with 5·7 per cent. of tannin, and 13 per cent. of alcoholic extract with 8·8 per cent. of soluble and insoluble tannins. The ether extract was very pale brown and semi-crystalline. It was soluble in water, giving an emerald green colour with ferric salts, red with soda solution, and dissolved in warm sulphuric acid with a purple colour changing to black—tests which point to the presence of catechin. The bark leaves 10·8 per cent. of mineral residue when burnt.

HARDWICKIA PINNATA, *Roxb.*

Fig.—*Bedd. Fl. Sylv.*, t. 255.

Hab.—Ghauts of Canara, Travancore, and the Carnatic.

Vernacular.—Kolávu (*Tinnevelly*), Madeyan, Sampirani (*Tam.*), Yenne (*Can.*), Shurali, Kolla (*Mal.*).

Description, Uses, &c.—The following account of it has been extracted from the *Pharmacographia* :—"The tree, which is of a large size, belongs to the order *Leguminosæ*, and is nearly related to Copaifera. According to Beddome, it is very common in the dense, moist forests of the South Travancore Gháts, and has also been found in South Canara. The natives extract the oleo-resin in exactly the same method as that followed by the aborigines of Brazil in the case of copaiba; that is to say, they make a deep notch reaching to the heart of the trunk, from which, after a time, it flows out.

"This oleo-resin, which has the smell and taste of copaiba, but a much darker colour, was first examined by one of us in 1865, having been sent from the Indian Museum as a sample of wood oil; it was subsequently forwarded to us in more ample quantity by Dr. Bidie of Madras. It is a thick, viscid fluid, which, owing to its intense tint, looks black when seen in bulk by reflected light; yet it is perfectly transparent. Viewed in a thin layer by transmitted light, it is light yellowish-green, in a thick layer vinous-red, hence is dichromic. It is not fluorescent, nor is it gelatinized or rendered turbid by being heated to 130° C., thus differing from wood oil. It may be further distinguished from wood oil as well as from copaiba, if tested in the following simple manner:—Put into a tube 19 drops of bisulphide of carbon and one drop of the oleo-resin,

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and shake them together. Then add one drop of a mixture of equal parts of strong sulphuric and nitric (1·42) acids. After a little agitation the appearance of the respective mixtures will be as follows :—

"*Copaiba*—Colour faint reddish-brown with a deposit of resin on the sides of the tube.

"*Wood Oil.*—Colour intense purplish-red, becoming violet after some minutes.

"*Oleo-resin of Hardwickia.*—No perceptible alteration ; the mixture pale greenish-yellow.

"By this test the presence in copaiba of one-eighth of its volume of wood oil may be easily shown.

"The balsam of Hardwickia has been used in India for gonorrhœa, and with as much success as copaiba." (*Op. cit.*)

Chemical composition.—Broughton, who has investigated it chemically, obtained by prolonged distillation with water an essential oil to the extent of 25 per cent. from an old specimen, and of more than 40 per cent. from one recently collected. The oil was found to have the same composition as that of copaiba, to boil at 225° C., and to rotate the plane of polarization to the left. The resin is probably of two kinds, of which one at least possesses acid properties. Broughton made many attempts, but without success, to obtain from the resin crystals of copaivic acid.

Trachylobium Hornemannianum, *Hoyne.*

Hab.—Africa. *Vernacular.*—Sandarús.

Gum Copal is administered internally in native practise as an astringent, anthelmintic, diuretic and emmenagogue ; with honey it is applied to remove opacities of the cornea, with olive oil it is dropped into the ear in earache, made into an ointment it is applied to wounds to promote granulation ; the fumes are inhaled in catarrh ; made into an ointment with pitch it is applied to ringworm. In Ajmere fine shavings of the gum made

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up into a medicine called *Khairva* are used to stop hæmoptysis. (*Irvine, Med. Top., p.* 132.) The gum is too well known as an article of commerce to require description.

CASSIA FISTULA, *Linn.*

Fig.—*Wight Ic., t.* 269; *Bentl. and Trim., t.* 87. Purging cassia, Indian Laburnum (*Eng.*), Casse Canéficier (*Fr.*).

Hab.—India, wild or planted. The fruit.

Vernacular.—Amaltás, Kirváli (*Hind.*), Bhava (*Mar.*), Gurmala (*Guz.*), Kakke-kàyi (*Can.*), Áhalla (*Cing.*), Konraik-kai, Sharak-konraik-kai, Mambala-konnai (*Tam.*), Sondhali (*Beng.*), Réla-káyalu (*Tel.*), Konnan (*Mal.*).

History, Uses, &c.—The Sanskrit names for the tree are Áragbadha, Suvarṅaka (golden), and Rajataru, or Nripadruma (royal tree), on account of the beauty of the long racemes of yellow flowers, which resemble those of the Laburnum, but are much larger. It is sacred to Ganeshwar, the St. Januarius of India; in Mysore stakes cut from the tree are fixed in the ground and worshipped. In Hindu medicine the pulp is used as a cathartic, and the root is also sometimes given as a laxative. A compound decoction (Áragbadhadi) is directed to be used by Chakradatta; it contains Cassia pulp, *Picrorrhiza Kurroa*, Chebulic myrobalans, long pepper root and *Cyperus rotundus*. (*Dutt's Hindu Mat. Med., p.* 155.) In Mahometan works the drug is called Khiyar-shambar, an Arabic corruption of the Persian Khiyar-chambar, and the pulp Asal-i-Khiyar-chambar (honey of Khiyar-chambar). Chambar means a necklace in Persian, and is probably an allusion to the structure of the pod. Persian dictionaries give Katha-el-Hind (Indian cucumber) as the Arabic name. Through the Arabians the drug became known to the later Greek physicians. Nicolaus Myrepsicus calls it γλυκοκάλαμον. Joannes Actuarius, who practised at Constantinople towards the close of the 13th century, describes it minutely.* In the *Makhzan-el-adwiya* the pods are directed to be slightly warmed, and the pulp extracted and rubbed up with a little almond oil for use. It is described as lenitive, useful for relieving thoracic obstructions, and heat of blood, a safe aperient for children, and women even when pregnant, but slow in its action. With tamarinds it is said to be a good purge for adust bile; with turbith or polypodium for cold humours and melancholy; with linseed or almond oil and combined with other suitable remedies, such as Dulcamara, it is recommended for the removal of obstructions of the abdominal viscera. Externally it is said to be a good application in gout, rheumatism, &c. The flowers and leaves are said to have lenitive properties, and a conserve of the former is mentioned. From 5 to 7 of the powdered seeds are prescribed as an emetic, and the shell of the pod rubbed down with saffron, sugar, and rose water, in difficult parturition. Ainslie notices the use of the pulp and flowers by the natives of India. Dr. Irvine (*Topogr. of Ajmeer*) states that he found the root act as a strong purgative. It is also reported to be in use as a purgative in Guzerat. In the Concan the juice of the young leaves is used to cure ringworm, and to allay the irritation caused by the application of the marking-nut juice. Rumphius remarks that the Portuguese make a confection of the young pods and also of the flowers. A peculiar gum swelling up in water like tragacanth issues from the tree when bruised. *C. brasiliana* and *C. moschata*, the Canafistola de purgar of Panama, Petite Casse d'Amérique of the French (*cf. Hanbury Science Papers*, p. 318), have been introduced into India, and have properties similar to those of *C. Fistula*.

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* Meth. Med. v, 2.

Description.—The ovary of the flower is one-celled, with numerous ovules, which, as they advance towards maturity, become separated by the growth of intervening septa. The ripe legume is cylindrical, dark chocolate brown, 1½ to 2 feet long, by ¾ to 1 inch in diameter, with a short strong woody stalk, and a blunt end suddenly contracted into a point. The fibro-vascular column of the stalk is divided into two broad

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parallel seams, the dorsal and ventral sutures running down the whole length of the pod. The sutures are smooth, or slightly striated longitudinally; one of them is formed of two ligneous bundles coalescing by a narrow line; each of the 25 to 100 seeds which a legume contains, is lodged in a cell formed by very thin woody dissepiments. The oval flattish seed, from 3-10th to 4-10th of an inch long, of a reddish-brown colour, contains a large embryo whose yellowish veined cotyledons cross diagonally, as seen on transverse section, the horny white albumen. One side is marked by a dark line (the raphe). A very slender funicle attaches the seed to the ventral suture. In addition to the seeds the cells contain a soft black pulp which has a mawkish sweet taste. (*Pharmacographia.*)

Chemical composition.—According to Braconnot, 20 parts of the pulp consist of sugar 12·00, gum 1·35, astringent matter, gluten, colouring matter and water make up the remaining portion, the water amounting to about 3·80.

C. Fistula roots.—The bark was carefully separated from the root-wood, the two dried separately and reduced to fine powder. The root-bark was astringent in taste, while the root-wood possessed a somewhat bitter-sweet flavour. The analysis showed the following results:—

	Root-bark.	Root-wood.
Water........................	10·01	8·21
Ash...........................	8·92	2·29
Petroleum ether extract...	·32	·52
Ether extract..................	2·17	·45
Absolute alcohol extract...	17·62	4·56

Manganese was absent in the ash both from the root-bark and root-wood; the former contained iron in very marked amount.

No alkaloidal principle could be detected; resins were present; astringent matter in very marked quantity in the root-bark, and to a small amount in the wood. The astringent matter was of the colour of kino, and afforded an inky coloration with ferric chloride; no gallic acid could be detected.

A principle soluble in petroleum ether was present both in the bark and wood, which yielded a bright red coloration with alkalies, the colour being changed to yellow by acids, and restored by alkalies. A bitter principle was also present to which the taste of the wood is probably due. In order to separate resins a large amount of the wood was exhausted with alcohol of 85 per cent., the alcohol evaporated off, water added to the extract, and the turbid mixture agitated with ether. During agitation chocolate-coloured flocks separated. The ethereal solution left on evaporation a reddish-yellow, soft, non-crystalline, and somewhat bitter residue. The aqueous solution, after dissolved ether had been expelled, was filtered to separate the chocolate-coloured flocks already mentioned, and the filtrate saturated with salt in order, if possible, to separate resin, but with negative results. The liquid was next agitated with acetic ether, the ether left on evaporation a slightly bitter principle, which was nearly wholly soluble in cold water. This principle, and the chocolate-coloured resin, insoluble in ether, were separately taken in doses of 0·1 of a gram. without producing any purgative action.

The pulp of *C. moschata* is in the form of dry circular discs, similar to small gun wads, of a light yellow colour, with a seed loose in the centre; it tastes astringent without any sweetness. The pulp dried at 100° C. lost 7·26 per cent. of moisture; on incineration it yielded 5·77 per cent. of ash, the composition of which presented nothing peculiar. To rectified spirit the pulp yielded 20·66 per cent. of extractive; dried at 100° C. the extract was acid; after extraction with cold water the insoluble residue was 4·55 per cent. calculated on the extract. This residue on drying formed dark easily friable lumps, which gave a dark chocolate coloured powder. In alkaline solutions it was soluble and was precipitated by acids in dark brown flocks; it had the properties of an acid resin. The aqueous solution of the alcoholic extract was concentrated, and when cold saturated with NaCl, light brown flocks separated; the liquid was filtered and the precipitate washed with a saturated solution of NaCl, the filter paper was then dried and digested

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with absolute alcohol. The extract obtained on evaporating off the alcohol amounted to 2·74 per cent. This extract was of a light fawn colour, easily soluble in alkaline solutions, somewhat soluble in water, and precipitated imperfectly from its alkaline solution by acids. It also possessed the properties of an acid resin. The filtrate obtained after precipitation of the second resin by NaCl, while still acid, was agitated with ether, the ether extract amounted to 0·16 per cent. After separation of the ether the aqueous solution, still acid, was agitated with amylic alcohol, by which 2·77 per cent. of extractive was obtained. The amylic alcohol extract was astringent to the taste, precipitated gelatine, gave a dirty olive-green precipitate with ferric chloride, and yielded a reddish solution with alkaline hydrates; no further examination of the aqueous solution was made. The purgative principle would appear to be one or both of the resins, 0·2 gram. of the first resin was dissolved in a few drops of ammonia, the liquid heated to expel excess of NH^3, diluted with water, and injected into a full grown cat's stomach. In 3·5 hours the cat was purged.

The pulp of *C. brasiliana* is soft, dark and sweet, with an offensive odour; butyric acid was detected in it. A crystallizable acid, soluble in ether, was also separated, as well as an acid resin and saccharine matter, and a principle soluble in ether which had an odour somewhat like vanillin.

Commerce.—Cassia pods (Casse en bâtons, *Fr.*) are worth in India about Rs. 14 per kandy of 5 cwts.

CASSIA TORA, *Linn.*

Fig.—*Rheede, Hort. Mal. ii., t.* 53; *Dil. Elt.* 63, *f.* 73.

Hab.—Throughout India. The leaves and seeds.

Vernacular.—Panwár, Çhakaund (*Hind.*), Kovaria (*Guz.*), Tákala, Tarota (*Mar.*), Tantepu-chettu, Tagarisha-chettu (*Tel.*), Ushit-tagarai, Tagarai (*Tam.*), Takkarike, Tegarasi (*Can.*), Tora (*Cingh.*).

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History, Uses, &c.—This plant is called by Sanskrit writers Chakramarda, "destroying ringworm," Prapunata or Prapunada, and Uranaksha; it has a great reputation in all kinds of skin-diseases. Chakradatta directs the seeds to be steeped in the juice of *Euphorbia neriifolia*, and afterwards to be made into a paste with cow's urine as an application to cheloid tumours. He also recommends the seeds together with those of *Pongamia glabra* as a cure for ringworm. The Arabs call the seeds Ain-es-sarátin, or crab's eyes. Under the names of Sanjisaboyah and Sangisaboyah, Mahometan writers give an exact description of the plant, and notice the closing of the leaves at night. They consider the seeds and leaves to have solvent properties in those forms of skin-disease accompanied by induration, such as leprosy, cheloid, psoriasis, &c., and mention their having been used with advantage in plague (waba), a term which is rather indefinite. *C. Tora* and *C. Sophera* are named Gallinaria by Rumphius. (*Hort. Amb. v.*, 97, figs. 1, 2.) Ainslie says:—"The mucilaginous and fetid smelling leaves of *C. Tora* are gently aperient, and are prescribed in the form of decoction; and in doses of about 2 ounces, for such children as suffer from feverish attacks while teething; fried in castor oil they are considered as a good application to foul ulcers. The seeds ground with sour buttermilk are used to ease the irritation of itchy eruptions; and the root, rubbed on a stone with limejuice, is supposed to be one of the best remedies for ringworm. The leaves are also used as a poultice to hasten suppuration." The plant is to be found as a weed in every garden, and is used as a domestic remedy in the manner described by Ainslie. In the Concan the following prescription is used for itch:—*Cassia Tora* seeds, 6 parts; *Psoralia corylifolia* seeds, 4 parts; carrot seeds, 2 parts; powder, soak in cow's urine eight days, and apply. Lately the seeds have been recommended as a Coffee-substitute. They are also used as a dye.

In India the young leaves are cooked and eaten on the four Saturdays in the month of Shravan; they are one of the five vegetables particularly acceptable to the gods; the others are *Bauhinia malabarica, Amarantus gangeticus, Celosia argentea,* and *Phalangium tuberosum.*

Description.—Leaflets 3 pairs, obovate, obtuse, glabrous, the terminal pair being much the largest, all folding up closely at night; flowers axillary, generally in pairs, dull yellow; legumes about 6 inches long, narrow, quadrangular, about $\frac{1}{8}$ of an inch in diameter, containing numerous elongated, very hard greyish seeds, the ends of which appear as if cut off obliquely. The whole plant has a fetid smell. The leaves when full grown are mucilaginous, and have a nauseous taste, but when young they are much used as a vegetable.

Chemical composition.—The seeds have been examined by Elborne (*Pharm. Journ., Sept.* 22*nd,* 1888), who found them to have the following percentage composition:—

Water	27·2
Petroleum ether extract	9·75
Ether extract	·86
Absolute alcohol extract	1·63
Watery extract	20·00

The ethereal extract and the alcoholic extract contained a glucosidal substance of a yellow colour insoluble in water, soluble in alcohol and in watery solutions of potash with a blood-red colour. These solutions are precipitated by hydrochloric acid. The precipitate has great analogies with chrysophanic acid, but according to Elborne appears to correspond with emodin in composition. Emodin ($C^{15}H^{10}O^{5}$) is trioxymethylanthraquinone and chrysophanic acid dioxymethylanthraquinone. The properties of the plant are due to the presence of emodin. In order to extract it the powdered seeds should be treated with dilute alcohol, the tincture filtered, and the alcohol distilled off. The residue is then to be diluted with water, acidulated with hydrochloric acid, boiled for ten minutes, and when cold agitated with ether which dissolves the emodin. Emodin agrees with chrysophanic acid in most of its properties,

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but may be distinguished by its insolubility in benzine, and greater solubility in ether and alcohol.

The leaves of this shrub contain a principle similar to cathartin, and a red colouring matter as in Senna leaves. They yield 18 per cent. of mineral matter on incineration.

Cassia alata, *Linn*, *Wight Ic.*, *t.* 253, is not a native of India, but has been introduced from the West Indies, where it has a reputation as a remedy for ringworm, and is used internally to promote expectoration, the action of the bowels and the secretion of urine.

The evidence which was collected by the authors of the *Pharmacopœia of India* is strongly in favour of its efficacy, and supports the favourable opinion of it expressed in the *Bengal Dispensatory*. The best way of applying it is to bruise the leaves and mix them with limejuice, the paste thus prepared is spread upon the affected part. The leaves have also purgative properties, and have been used in the same manner as Senna.

Description.—The leaves are two feet long or more, and consist of a triangular petiole, with from 8 to 14 pairs of leaflets. The first pair are the smallest, and are placed near the branch and separated from the second pair by a longer interval than there is between the other pairs. The terminal leaflets are as much as 5 to 6 inches in length. They are all obovate-oblong, obtuse, mucronate, and glabrous on both sides, and taste like Senna, but less nauseous.

This shrub has no proper Vernacular names, but is known in Southern India as "*foreign Sesbania grandiflora*," *e. g.*, Shimai-agatti (*Tam.*), and in Bengal as "*Ringworm shrub*," Dádmardan. Late Sanskrit writers have given it the name of Dádrughna, which has the same meaning.

CASSIA AURICULATA, *Linn.*

Fig.—*Pluk. Alm.*, *t.* 314, *f.* 4.

Hab.—Central Provinces, W. Peninsula, Ceylon. The bark and seeds.

Vernacular.—Tarwar (*Hind.*, *Mar.*), Avala (*Guz.*), Avirai (*Tam.*), Tangedu (*Tel.*), Tangádi-gida, Avara-gida (*Can.*), Ranavara (*Cingh.*).

History, Uses, &c.—Ainslie says:—"The small, flat, pleasant-tasted, heart-shaped seeds of this species of Cassia, the Vytians reckon amongst their refrigerants and attenuants, and prescribe them in electuary, in cases in which the habit is preternaturally heated, or depraved. They also consider the powder of the dry seeds as a valuable external remedy (blown into the eye), in certain stages of ophthalmia; of the electuary the dose is a small teaspoonful twice daily. Dr. Kirkpatrick (*Cat. of Mysore Drugs*) brings to notice the astringent properties of the bark, and speaks favourably of the use of the seeds as an application to the eyes in chronic purulent conjunctivitis.

C. auriculata is of great importance to the tanner; and to workers in iron, who use the root in tempering iron with steel. (*Gibson.*). Another common use to which the wood is applied is the making of Datwans, or native tooth-brushes; for this purpose it is preferred to that of any other plant. The shrub yields an adhesive gum.

Dr. P. S. Mootooswamy informs us that in Tanjore the root is used in decoction as an alterative, as well as a medicinal oil prepared from the bark, which is called in Tamil *áverai-yennai.* The leaves infused yield a cooling drink, and ground to a paste with water and the seeds of *Phaseolus radiatus* and poppy seed they are applied to herpetic eruptions. From the flowers a tea is prepared which is prescribed in diabetes. A compound syrup is prepared with the flowers, mocharas, and Indian sarsaparilla which is prescribed for nocturnal emissions. The seeds are also used in diabetes and ophthalmia, a compound powder made with all the parts of the plant is considered a specific in the former affection; it is called *áverai-panjhangum* in Tamil, and is administered mixed with honey in doses of a tea-spoonful. Dr. Mootooswamy states that he has known diabetes and chylous urine to be cured by it.

Description.—The bark as generally met with is about as thick as cinnamon, nearly smooth, externally reddish-brown, internally olive-green; it occurs in small strips or quills. Taste sweetish, and moderately astringent. Sections examined under the microscope show a deposit of crystals arranged like rows of beads in the course of the vessels, otherwise there is nothing remarkable. The seeds are smooth, flat, of an oval, oblong, or obscurely triangular form, obtusely pointed at one end. Their colour is brown, or dull olive-green; they are tasteless and inodorous.

Chemical composition.—The young bark yields 22·3 per cent. of aqueous extract, and 24·8 per cent. of alcoholic extract; in the former was estimated 11·9 per cent. of tannin, and in the latter 14·2 per cent. The tannin gave a greenish precipitate with ferric salts. The bark contained 7·3 per cent. of moisture and 4·1 per cent. of ash.

CASSIA SOPHERA, *Linn.*

Fig.—*Jacq. Ic., t.* 73; *Rheede, Hort. Mal. ii., t.* 52.

Hab.—Himalayas to Ceylon. Cosmopolitan in the tropics. The leaves, seeds and roots.

CASSIA OCCIDENTALIS, *Linn.*

Fig.—*Bot. Reg. t.* 83. Negro Coffee (*Eng.*), Cafetier des négres (*Fr.*).

Hab.—Cosmopolitan in the tropics, probably introduced into India. The seeds and leaves.

Vernacular.—Kasondi, Gajarság, Sari-Kasondi (*Hind.*), Rántákala (*Mar.*), Kasonda (*Beng.*), Ponna-virai, Pera-verai (*Tam.*), Tagara-chettu, Paidi-tangedu (*Tel.*), Dodda-tagase (*Can.*).

History, Uses, &c.—Cassia Sophera, in Sanskrit Kasamarda, "destroyer of cough," is a native of India, whilst *C. occi-*

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dentalis appears to have been introduced, but is a widely scattered plant from the Himalayas to Ceylon. The natives usually call both plants by the same name, but if they wish to distinguish them the adjective 'black' is applied to *C. Sophera.*

These plants are supposed by the Hindus to have expectorant, depurant and alterative properties, and the roots are given with black pepper as a remedy for snake bites. The seeds of *C. Sophera* and of *Raphanus sativus* are rubbed into a paste with sulphur and water and applied to patches of pityriasis and psoriasis, and a paste of the root with sandalwood is used for the same purpose. Mahometan writers treat the two plants as varieties of the same species; they describe Kasondi as alexipharmic, useful in the expulsion of corrupt humours and to relieve cough, especially whooping cough. Both plants are purgative, the dose of the leaves being about 90 grains. In the Concan 4 to 12 grains of the seeds are pounded and heated with 3 drachms of women's or cow's milk, strained, and given once a day as a cure for the convulsions of children, or a larger dose may be given to the mother or wet nurse; as in the case of senna, the purgative effects are communicated to the milk.

In the French-African colonies the seeds of *C. occidentalis* are called "negro coffee;" they are employed there and in the West Indies as a febrifuge, chiefly in the form of vinous tincture (℥ii to Oij of Malaga wine), an infusion of the root is considered by the American Indians to be an antidote against various poisons, and a decoction of the whole plant is a popular remedy in hysteria; it relieves spasm and expels wind in the intestines. Torrefaction is said to destroy the purgative principle in the seeds, and make them taste like coffee.

In Gambia the root is used as a preventive of fever, a decoction being taken every morning; and the leaves are applied in erysipelas and local inflammations.

Description.—*C. Sophera.*—Erect, branched, glabrous; leaflets 6 to 12 pair, lanceolate, or oblong-lanceolate, acute; with a single gland near the base of the petiole; racemes terminal or axillary, few flowered; upper petal retuse;

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legumes long, linear, turgid, glabrous, many-seeded; suture keeled; seeds horizontal with cellular partitions; flowers middle-sized, yellow. The plant has a heavy disagreeable smell, and a purplish tinge; the root is fibrous and woody, with a blackish bark giving it the appearance of having been burnt, and has a strong odour of musk. It springs up upon waste ground during the rains, and flowers in November. The plants often last for several years, and attain a considerable size.

C. occidentalis.—Erect, branches glabrous; leaflets 3 to 5 pairs, without glands between them, ovate-lanceolate, very acute, glabrous on both sides; petiole with a large sessile gland near its tumid base; flowers longish-pedicelled, yellow, upper ones forming a terminal raceme, lower ones 3 to 5 together on a very short axillary peduncle; legumes long, surrounded with a tumid border. The seeds are of a grey colour, and of the shape of rounded discs, from $\frac{3}{16}$ to $\frac{4}{16}$ of an inch in diameter, and $\frac{1}{16}$ of an inch in thickness. The plant appears in the rains upon waste ground and rubbish; it has a sickly offensive smell, and closely resembles *C. Sophera.*

Chemical composition.—The roots of *C. Sophera* contain a resinous substance affording fine red solutions with alkalies, and a bitter principle, not of an alkaloidal nature, in the aqueous solution of the alcoholic extract. Water dissolves out a red pigmental glucoside yielding a decomposition product insoluble in water. The leaves contain cathartin, colouring matter, and 12 per cent. of saline residue. Examined by Clonet (1876), the seeds of *C. occidentalis* were found to contain:—Fatty matters (olein and margarin), 4·9; tannic acid, 0·9; sugar, 2·1; gum, 28·8; starch, 2·0; cellulose, 34·0; water, 7·0; calcium sulphate and phosphate, chrysophanic acid, 0·9; malic acid, sodium chloride, magnesium sulphate, iron, silica, together, 5·4; and achrosine, 13·58 parts in 100. The latter substance was obtained by exhausting the powder of the seeds previously treated with ether, by means of alcohol of 60 per cent. The alcohol is distilled off, the syrupy residue treated with absolute alcohol, which dissolves out various constituents, leaving a solid brown

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red mass, having when dry a resinous fracture, and being soluble in water, to which it communicates a garnet colour. It contains C,H,O,N, and S, but its exact composition has not been determined (it is most likely a mixture of various bodies). It is soluble also in weak alcohol, and in acids and alkalies. The colour cannot be fixed upon tissues by any known mordant. This circumstance induced Professor Clonet to term it achrosine, or "not colouring," although being coloured itself. The seeds are the most active part of the plant, and readily act as an emeto-cathartic. (*Year-Book of Pharmacy*, 1876, *p*. 179.)

We have separated the colouring matter as above described, and after dissolving in water and filtering, the solution was boiled, whereupon most of the colour was thrown down as a brown precipitate. The precipitate was well washed, dried and powdered. The powder, of a greenish brown colour, was very soluble in ether and alcohol, and sparingly soluble in benzol, and separated on evaporation of the solvent into yellow crystals which became red on exposure to the air. It melted at 245° C., and at a higher temperature gave off yellowish green fumes partly subliming in yellow needles which struck a fine red colour with caustic potash and orange brown with sulphuric acid. These and other tests indicate the presence of an anthraquinone derivative very closely allied to emodin.

The powdered seeds burnt with soda lime yielded 2·75 per cent. of nitrogen, which, calculated into proteids, shows the presence of 17·4 per cent.

Commerce.—The seeds of these plants are not collected in India, but in Senegal they are used as a coffee substitute, and are exported to some extent.

CASSIA ABSUS, *Linn.*

Fig.—*Burm. Zeyl.*, *t.* 97.

Hab.—W. Himalayas to Ceylon. The seeds.

Vernacular.—Cháksú, Chákút (*Hind.*), Kánkuti, Chimr (*Mar.*), Chinol (*Guz.*), Karunkánam, Káttukkol (*Tam.*), Chanupála-vittulu (*Tel.*), Bu-tora (*Cing.*).

History, Uses, &c.—These seeds were used by the ancient Egyptians, through them the Greeks and Romans became acquainted with the drug. Dioscorides notices them as produced in Egypt, and calls them Akákális.* Mahometan writers following the Greeks describe the seeds as attenuant and astringent, and say that they strengthen the sight when used as a collyrium; they direct them to be prepared by enclosing them in a little dough and placing them inside an onion, which is then baked. The Arabic names for the seeds are Hab-es-soudán, and Tashmízaj, the latter being a corruption of the Persian Chashmizak. In Persia they are also called Cheshmak and Chashúm. According to Ibn Baitar, those which come from the Soudan are the largest and best. In some books a plaster made from the seeds is recommended as an application to wounds and sores, especially of the penis. In purulent conjunctivitis about a grain of the powdered seed prepared in the manner already mentioned is introduced beneath the eyelids. M. Cailliaud gives us the following description of the use of the seeds in Egypt:—"On concasse les grains et on les monde de leur tunique; elles se réduisent en une poudre jaunâtre que l'on met sèche en petite quantité à l'intérieur de la paupière inférieure, que l'on a eu soin d'abaisser. On verse la poudre entre le globe de l'œil et la paupière, en faisant tomber doucement cette poudre de dessus une petite pièce de monnaie où on l'a placée. Cette application cause une cuisson et une gêne, qui font tenir les paupières fermées, et qui font couler des larmes. La douleur se dissipe par degrés, en une demi-heure ou un peu plus; et les yeux, qui étaient fort injectés de sang avant et pendant l'opération, diminuent de rougeur, reprennent l'éclat de la santé, et font succéder une sensation de bien-être à l'appesantissement et á l'incommodité qui ont précédé. L'expérience nous a fait concevoir l'utilité de ce remède, dans le cas où l'inflammation, devenue chronique, est entretenue par un relâchement des parties. (*Centurie de Plantes d'Afrique*, p. 26.) The drug was tried by Dr. Harbauer at Brussels in 1822 with satisfactory results. (*Confer. Graefe and Walthers Jour.*, 1825, Vol. VI., p. 1.) Dr. G. Smith, who tried it in the Eye Infirmary at Madras, thinks it a painful and dangerous application in ophthalmia and granular lids. He does not say, however, whether the seeds were baked before they were applied.

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* Dios. i., 103.

Description.—Cháksu seeds are black and polished, flat, of an irregular oval or oblong shape; the end where the hilum is situated is rather more pointed than the other, length and breadth nearly alike, about $\frac{1}{5}$ to $\frac{1}{6}$ of an inch; testa horny and thick; cotyledons yellow; taste bitter.

Chemical composition.—The seeds reduced to fine powder lost 13·54 per cent. at 100° C. The ash amounted to 3·74 per cent., and contained a trace of manganese.

On analysis the following results were obtained:—

Petroleum ether extract	....	6·24	per cent.
Ether ,,	....	·16	,,
Absolute alcohol ,,	....	1·75	,,
Cold water ,,	....	22·56	,,

The petroleum ether extract was of a bright yellow colour, and consisted of a non-drying oil, insoluble in alcohol. No red coloration was produced by alkalies: saponified with alcoholic potash, and the soap treated with petroleum ether, it yielded no extractive.

The ether extract consisted wholly of a trace of oily matter, completely soluble in petroleum ether.

The alcoholic extract was yellow, brittle, and hygroscopic, and without bitterness. By treatment with water a yellow solution was produced which gave a brown coloration with ferric chloride. Extracted with water acidulated with sulphuric acid, the solution afforded marked indications of the presence of an alkaloidal principle. Alkalies imparted a bright yellow coloration to the solution. The extract also contained a yellow resin insoluble in alkalies.

The aqueous extract reduced an alkaline copper solution on boiling, and gave a precipitate with acetic acid and ferrocyanide of potassium.

The residue insoluble in water contained no starch.

Commerce.—The seeds are collected in many parts of India. Value, Rs. 4 per Surat maund of 37½ lbs.

CASSIA ANGUSTIFOLIA, *Vahl.*

Fig.—*Royle Ill., t.* 37; *Bentl. and Trim., t.* 91. Senna (*Eng.*), Séné (*Fr.*). The leaves.

Hab.—Africa. Cultivated in India.

Vernacular.—Sana-maki, Sona-maki (*Hind., Mar., Guz.*), Nilavirai (*Tam., Can.*), Nelaponna (*Tel.*).

History, Uses, &c.—Senna was first used as a purgative medicine by the early Arabian physicians, who introduced it into Europe. The Sana-maki of native works on Materia Medica is Arabian Senna imported into India. The same species has latterly been cultivated in this country, especially about Tinnevelly, from which place large quantities of the leaf are exported to Europe. In the Bombay market Indian grown Senna is now always obtainable; much also passes through the port on its way to Europe, being brought up from Tuticorin by the steamers which ply round the coast. Bombay is, moreover, the chief port for the importation of Arabian Senna, which is shipped from Mokha, Aden, and other Red Sea ports, and, re-exported, is known in Europe as Bombay Senna.* Sana-maki is described in native works on Materia Medica as a purgative of phlegm and adust bile, clearing the brain, and acting as an attenuant of the system generally; it is considered especially useful in those diseases which are caused by an accumulation of corrupt humours, such as gout, rheumatism, &c. It is also thought to clear the skin of pimples, to expel worms from the intestines, and to remove any tendency to piles. Senna is prescribed in decoction and as a confection. A plaster made by mixing the powdered leaves with vinegar is recommended in skin affections; and combined with Henna is used to dye the hair black. In the Concan the seeds with those of *Cassia Fistula* are pounded with curds and applied to cure ringworm; the seeds of *Cassia obovata* are used in a similar manner. Senna appears to have been introduced into Europe by the Arabians about the ninth century. In France, in 1542, a pound of Senna was valued at 15 sols, the same price as pepper or ginger. The Arabian Senna, called Sana Hajazi or Jabali, is the produce of the uncultivated plant; it is collected by the Arabs in a careless manner, and is much mixed with pods, flowers, and portions of the stem; the natives consider the pods to be quite as efficacious as the leaves.

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* The importation of Arabian Senna is rapidly declining owing to the large quantity of Tinnevelly leaves now offered at extremely low rates.

The therapeutic action of Senna pods, as differing widely from that of Senna leaves, is the subject of an interesting note by Dr. A. W. Macfarlane. (*Lancet, July 27th*, 1889.) He finds that an infusion of the pods presents the advantage of being almost free from taste and devoid of the characteristic odour and flavour of the leaves. It appears to increase activity in the muscular movements of the whole gastro-intestinal canal, acting quite as much on the colon and rectum as on the small intestine. It is slower in its action than an infusion of the leaves, but equally certain; an ordinary dose producing one motion, seldom more, of soft consistence, in from eight to ten hours, without exciting congestion of the pelvic vessels, increasing hæmorrhagic or menstrual discharges, or causing griping or flatulence. When administered regularly for several nights, it promotes the natural evacuation of the bowels, so that the quantity taken has to be decreased and eventually stopped. It has been found useful in cases of hæmorrhoids and in constipation of children as well as the aged.

Description.—Leaves 5—8, jugate, oval-lanceolate, tapering from the middle towards the apex, from 1 to 2 inches long, glabrous or scantily pubescent, pale or subglaucous, subsessile. Legume from 7 to 8 lines broad; with the base of the style distinctly prominent on its upper edge; seeds obovate-cuneate, compressed; cotyledons plain, extending the large diameter of the seed in transverse section. (*Oliver.*)

Chemical composition.—According to the researches of Lassaigne and Feneulle (1821), Bucheim and Lundermann (1856) and Kubly (1865), the active principle of senna leaves is *cathartin,* a combination of *cathartic acid* with one or more earthy bases. Cathartic acid has been shown to be formed of carbon, hydrogen, oxygen, nitrogen and sulphur; it is quite soluble in alcohol, but the salts are insoluble, hence the cathartin is prepared by precipitating an aqueous extract with a large excess of rectified spirit. The active principle of Senna is, according to D. R. Stockman (1885) (*Arch. für exper. Pathol und Pharm. and Pharm. Journ.* [3], *XV.*, 749,) a yellow colouring matter, not containing any nitrogen or sulphur, and derived from a mixture of a derivative of anthracene with a colloid hydrate of carbon. Dr. Stockman obtained this substance by treating Senna leaves with alcohol acidulated with weak sulphuric acid, afterwards with hot alcohol; the result of this process was precipitated by hydrate of baryta. In the precipitate and in the filtered liquid cathartic acid is found, which is dissolved and shaken with ether, and the acid is then combined with baryta or lead. The liquid which contains the active principle is evaporated after being treated with sulphuretted hydrogen, and the resulting product dried over sulphuric acid.

A solution of this substance neutralised by carbonate of soda and administered to rabbits produced a violent diarrhœa, in large doses it is poisonous; injected hypodermically or into the veins it produces no effect. (*Archiv. der. Phar.*, *Journ de Phar. et de Chim.*, 1886.)

The sugar of Senna leaves was isolated by Kubly in 1865, and named *Catharto-mannit.* A. Seidel, 1885, has further examined this substance, for which he proposes the name "*Sennit.*" The most satisfactory process for preparing this sugar was by concentrating in vacuo the aqueous infusion of the leaves, precipitating mucilage and salts from the syrupy liquid by two volumes of strong alcohol, filtering, distilling off the alcohol, diluting the residue with water, digesting for 24 hours with oxide of lead, again evaporating in vacuo to a syrupy consistence, crystallizing upon flat plates over quicklime, which requires four or five weeks, and purifying by recrystallization from methyl alcohol and washing with absolute alcohol. Thus prepared sennit has the composition $C^6H^{12}O^5$, and forms colourless microscopic hemiedric crystals of the rhombic system, mostly sphenoids with curved sides. It has a very sweet taste, melts at 183° C. (corrected 185·°6), and is soluble at the ordinary temperature (about 20°C.) in $1\frac{3}{4}$ parts of water, 450 of absolute alcohol, 48 of alcohol of 90 p. c., 82 of methyl alcohol, and about 10·500 parts of absolute ether. It is dextrogyrate, unfermentable, prevents the precipitation of copper and iron salts by alkalies, and does not reduce Fehling's solution (even after boiling with acid), silver nitrate, or solutions of gold or platinum. By treatment with dilute nitric acid, it yields oxalic acid, but no mucic acid. On evaporating sennit with an excess of dilute nitric acid, a snow-white mass is left, which dissolves with an intense yellow or yellowish colour in sodium acetate; on the addition to the ammoniacal solution of a drop of barium chloride solution, a reddish brown precipitate is produced, the liquid gradually becomes rose-coloured, and on spontaneous evaporation leaves a raspberry red residue. Similar colorations are produced by strontium chloride, but the residue is in transmitted light rose-coloured, while in reflected light it is green, and has a metallic lustre. These characteristic colour reactions are at once produced in the solution in sodium acetate mentioned above. Inosit, quercit, and probably pinit, give a similar reaction; but not mannit, dulcit, glucose or saccharose. Compounds with calcium, barium and lead were prepared; also an acetyl compound, showing sennit to be a pentatomic alcohol. (*Amer. Jour. Pharm., Nov.*, 1885; *Year-Book of Pharm.*, 1886.) Two comparative experiments with senna pods by E. F. Salmon (*Pharm. Journ., Oct. 12th*, 1889) showed that they are richer in cathartin than the leaves, and are practically free from the resins and volatile oil contained in them.

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From the examination of the ash of some samples of Tinnevelly senna, Heisch reports that the average is 11·35 per cent.; of this 2·43 parts are soluble in water, 8·66 are soluble in acid, and 0·26 are insoluble. This composition is very similar to that of the ash of Alexandrian senna leaves.

It has been shown in a paper by C. L. Diehl (*Pharm. Journ., March 18th*, 1876), that senna leaves when treated with alcohol and dried, will give preparations, which while possessing the purgative qualities of the leaves, are tasteless and do not gripe.

Cold water readily dissolves the cathartin from the pods, which it will not do from the leaf, owing to the impervious nature of its epidermis.

Commerce.—The imports of Arabian Senna into Bombay for many years amounted to about 5,000 cwts. annually; half this quantity was re-exported. Value, Rs. 5 to 6 per cwt. It was brought from Jedda, Aden, and Zanzibar, but now it is hardly obtainable, having been driven out of the market by Tinnevelly Senna.

Tinnevelly Senna is exported from Tuticorin, and the season for collecting the leaves extends from June to December. The exports during the last five years were as follows :—

Year.	Foreign.		British Ports in other Presidencies.		British Ports within the Presidency.		Total.	
	Cwts.	Value, Rs.	Cwts.	Value, Rs.	Cwts.	Value, Rs.	Cwts.	Value, Rs.
1883-84 ...	8,469	83,772	1,682	16,343	...	...	10,151	1,00,115
1884-85 ...	6,688	83,494	4,364	32,208	...	...	11,052	1,15,702
1885-86 ...	9.575	36,369	2,506	32,302	139	780	12,861	69,451
1886-87 ...	10,205	1,39,808	2,911	31.904	...	...	13,116	1,71,712
1887-88 ...	17,422	2,66,690	3,954	52,179	...	...	21,376	3,18,869

CASSIA OBOVATA, *Collad.*

Fig.—*Wight Ic., t.* 757; *Bentl. and Trim., t.* 89. Italian Senna (*Eng.*), Sené d' Italio (*Fr.*).

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Hab.—Punjab, Sind, W. Peninsula. The herb.

Vernacular.—Surati-sonamukhi (*Guz.*), Bhui-tarwar (*Mar.*), Nilavagai (*Tam.*)

Description, Uses, &c.—This plant is the *C. obtusa* of Roxburgh. It is very common in many parts of India, but is not cultivated. The whole plant in seed is sometimes offered for sale in the bazar as country senna, in contradistinction to the senna which is in general use, and which was formerly imported from Arabia. *C. obovata* is perennial, herbaceous, and diffuse; leaflets 4 to 6 pair, obovate obtuse, mucronate, glabrous; racemes axillary, few flowered, much shorter than the leaves; legumes lunate, broad, thin, obtuse; valves crested at the seeds. It is used as a substitute for the official Senna, and is also in Southern India applied to cure psoriasis and pityriasis. The following notice of it occurs in the *Pharmacographia*:—"This species was the first known to botanists, and was cultivated in Italy for medicinal use during the first half of the 16th century. Hence the term Italian senna used by Gerarde and others. It is more widely distributed in the Nile region than the other species, and is also found in India, and (naturalized) in the West Indies. Its leaflets (also pods) may occasionally be picked out of Alexandrian senna. It is called by the Arabs *senna baladi* (wild senna), and grows in the fields of durra (*Sorghum*) at Karnak and Luxor, and in the time of Nectoux was held in such small esteem that it fetched but a quarter of the price of the *senna jebeli* brought by the caravans of Nubia and the Bisharrin Arabs. It is not now collected."

Being very abundant in India it might occasionally be found useful as a substitute for officinal Senna. In the earlier part of the season it is frequently found mixed with the Tinnevelly senna, and is known in South India as the blunt leaf or jungle senna.

Chemical composition.—See *Cassia angustifolia.*

Other allied plants sometimes used medicinally in India are **Cynometra ramiflora**, *Linn.*, which has purgative pro-

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perties, and the leaves of which, boiled in milk and mixed with honey, are used as an application to scaly cutaneous eruptions In Nepaul the leaves of **Colutea nepalensis**, *Sims.*, are used as a purgative.

TAMARINDUS INDICA, *Linn.*

Fig.—*Bedd. Fl. Sylv.*, *t.* 184; *Bentl. and Trim.*, *t.* 92.

Tamarind tree (*Eng.*), Tamarinier de l'Inde (*Fr.*). The pulp, leaves and seeds.

Hab.—Africa (?) Cultivated throughout the tropics.

Vernacular.—Imlí, Amlí (*Hind.*, *Guz.*), Chintz (*Mar.*), Puliyam-pazham (*Tam.*), Tentúl (*Beng.*), Chinta-pandu (*Tel.*), Hunase (*Can.*).

History, Uses, &c.—There would appear to be little doubt that the Tamarind tree is a native of some part of India, probably the South. It is found in a cultivated or semi-cultivated state almost everywhere, and the fruit, besides being an important article of diet, is valued by the Hindus as a refrigerant, digestive, carminative and laxative, useful in febrile states of the system, costiveness, &c. The ashes of the burnt suber are used as an alkaline medicine in acidity of the urine and gonorrhœa, the pulp and also the leaves (puliyam-gali, *Tam.*), are applied externally in the form of a poultice to inflammatory swellings.

The Sanskrit names of the Tamarind are Tintidi and Amlika. The word 'Tamarind' appears to be derived from the Arabic Tamar-Hindi (Indian date), and it was doubtless through the Arabians that a knowledge of the fruit passed during the Middle Ages into Europe, where, until correctly described by Garcia d'Orta, it was supposed to be produced by a kind of Indian palm.

The author of the Makhzan-el-Adwiya describes two kinds, *viz.*, the red, small-seeded Guzerat variety, and the common reddish brown. The first is by far the best. Mahometan

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physicians consider the pulp to be cardiacal, astringent and aperient, useful for checking bilious vomiting, and for purging the system of bile and adust humours; when used as an aperient it should be given with a very small quantity of fluid. A gargle of Tamarind water is recommended in sore throat. The seeds are said to be a good astringent, boiled they are used as a poultice to boils, pounded with water they are applied to the crown of the head in cough and relaxation of the uvula. The leaves crushed with water and expressed yield an acid fluid, which is said to be useful in bilious fever, and scalding of the urine; made into a poultice they are applied to reduce inflammatory swellings and to relieve pain. A poultice of the flowers is used in inflammatory affections of the conjunctiva; their juice is given internally for bleeding piles. The bark is considered to have astringent and tonic properties. (*Makhzan-el-Adwiya.*) The natives consider the acid exhalations of the Tamarind tree to be injurious to health, and it is stated that the cloth of tents allowed to remain long under the trees becomes rotten. Plants also are said not to grow under them, but this is not universally the case, as we have often seen fine crops of *Andrographis paniculata* and other shade loving plants growing under Tamarind trees. Mr. J. G. Prebble has brought to our notice a peculiar exudation from an old tamarind tree. It consists almost entirely of oxalate of calcium, and flows from the tree in a liquid or syrupy state, but afterwards dries into white crystalline masses.

Description.—The fruit is an oblong or linear-oblong, slightly compressed, curved, or nearly straight, pendulous legume, of the thickness of the finger, and 3 to 6 inches in length, supported by a woody stalk. It has a thin but hard and brittle outer shell or epicarp, which does not split into valves, or exhibit any very evident sutures. Within the epicarp is a firm, acid juicy pulp, on the surface of which and starting from the stalk are strong woody ramifying nerves; one of these extends along the dorsal (or concave) edge, two others on either side of the ventral (or convex) edge, while between these two there are usually 2 to 3, or 4 less regular and more slender nerves,

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all running towards the apex and throwing out branching filaments. The seeds, 4 to 12 in number, are each enclosed in a tough, membranous cell (endocarp), surrounded by the pulp (sarcocarp). They are flattened, and of irregular outline, being roundish ovate, or obtusely four-sided, about 6-10th of an inch long by 3-10th thick, with the edge broadly keeled or more often slightly furrowed. The testa is of a rich brown, marked on the flat sides of the seed by a large scar or areole, of rather duller polish than the surrounding portion, which is somewhat radially striated. The seed is exalbuminous, with thick hard cotyledons, a short straight included radicle and a plumule in which the pinnation of the leaves is easily perceptible. (*Pharmacographia.*) The Indian commercial article forms a firm, black, sticky mass; with the pulp are mixed seeds, fibres and small fragments of the shell; it is usually salted. For pharmaceutical purposes it should be free from salt.

Microscopic structure.—Tamarind pulp consists of thin-walled cells; amongst them may be seen crystals, which are probably acid tartrate of potash.

Chemical composition.—According to Flückiger and Hanbury water extracts from unsweetened Tamarinds, sugar together with acetic, tartaric, and citric acids, the acids being combined for the most part with potash. The neutralized solution reduces alkaline cupric tartrate after a while without heat, and therefore probably contains grape sugar. On evaporation, cream of tartar and sugar crystallize out. In East Indian Tamarinds citric acid is present in but small quantity. No peculiar principle to which the laxative action of Tamarinds can be attributed is known. The fruit pulp diffused in water forms a thick tremulous somewhat glutinous and turbid liquid owing to the presence of pectin. The testa of the seeds abounds in tannin, and after long boiling can be separated, leaving the cotyledons soft. The latter have a bland mucilaginous taste. Brannt states that the seeds contain 20 per cent. of a thickly fluid oil with an odour of linseed, and classes it with the non-drying oils. By expression from the dry seeds we were unable to obtain any oil, and by solvents the yield was only 3·9 per cent. The oil possessed greater siccative properties than boiled linseed oil.

C. Mueller has examined nine samples of East Indian Tamarinds with the following results:—

Seeds.	Pulp free from seeds.					Dry pulp.	
	Water.	Insol.	Pot. Bitart.	Tart. acid.	Citric acid	Pot. Bitart.	Tartaric acid.
Highest % 38·0 ………	30·81	20·2	6·01	8·80	3·95	8·25	12·25
Lowest % 1·5 ………	21·92	12·2	4·66	5·29	0·64	6·21	6·77
Average % 13·9 ………	27·00	16·2	5·27	6·63	2·20	7·20	9·09

He found very small quantities of malic acid, which were calculated as citric acid.—(*Pharm. Centralhalle*, 1882, *Nos.* 49 *and* 50.)

Commerce.—Large quantities of Tamarinds are shipped to Persia and other northern countries. Some go to Europe, where they are used for pharmaceutical purposes. The red kind from Guzerat is most esteemed, and is worth Rs. 50 per kandy of 7 cwts. Some of the inferior kinds are not worth more than Rs. 20.

The pulp is prepared for the market by removing the seeds and epicarp by hand; the pulpy portion is then usually mixed with about 10 per cent. of salt and trodden into a mass with the naked feet; there are several qualities in the market, the chief difference being in the amount of care which has been taken in preparing them, the best is free from fibre and husk, the worst contains both as well as the seeds. Careful housekeepers prepare their own pulp, and expose it for a week to the sun and dew to ripen it.

Tamarind seeds are universally eaten by the natives; they are first roasted and soaked to remove the outer skin, then boiled or fried, when they become tolerably palatable. In the

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raw state they are used by the poor as an astringent masticatory like betelnut. A size made from the seeds is used as a dressing to country-made blankets.

BAUHINIA VARIEGATA, *Linn.*

Fig.—*Rheede, Hort. Mal i., t.* 32.

Hab.—India. The bark.

Vernacular —Kachnár (*Hind.*), Kanchana (*Mar.*), Kánchan (*Beng.*), Kanchivala (*Can.*).

History, Uses, &c.—There are two varieties of this Bauhinia. The flowers of the one are purple, or deep rose-coloured, and of the other white, yellow and green; both are noticed in the Bhavaprakása under the names of Kovidara and Kanchanára, and are said to have similar properties, the bark being described as alterative, tonic, astringent and useful in scrofula, skin diseases, and ulcers. Chakradatta recommends the bark of the first variety in scrofulous enlargements of the cervical glands, and directs it to be given in emulsion with rice-water and ginger. Sárangadhara also recommends it for a similar purpose, and prescribes it in combination with guggulu (gum-resin of *Boswellia serrata*), myrobalans, and a number of aromatics. In the Concan the juice of the fresh bark with the juice of the flowers of *Strobilanthes citrata*, 10 tolás of each, is given as an expectorant, and the bark is used with ginger as an internal remedy for scrofula. Under the name Kachnár, the author of the Makhzan describes the bark as astringent, attenuant and tonic. He says it is used to check diarrhœa, to remove intestinal worms, and prevent the decomposition of the blood and humours; on this account it is useful in leprosy and scrofula. A gargle made from the bark with the addition of Akákiá (extract of Acacia pods) and Pomegranate flowers is mentioned as a remedy in salivation and sore throat, and a decoction of the buds in cough, bleeding piles, hæmaturia and menorrhagia.

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Description.—The bark is grey, tolerably smooth, compact, fracture granular, reddish brown, the external surface is covered thickly with little elliptic warts of a darker colour than the rest of the bark, the internal surface is white. The taste is feebly astringent; microscopic examination discovers nothing characteristic.

The juice of the fresh leaves of **B. racemosa**, *Lam. Hook. Ic., t.* 141; *Bedd. Fl. Sylv., t.* 182, mixed with black pepper, is applied to the head in fever attended with headache. This tree is known by the Sanskrit names of Apata and Vana-raja, and its leaves are worshipped and distributed as gold at the Dasara festival. The bark is highly astringent, and is administered by the natives in chronic dysentery and diarrhœa. A dry extract made from it very closely resembles kino in appearance and properties; it occurs in purplish red fragments, soluble in water, and only partially in spirit. In Pudukota, where the tree is called Kattathi, the leaves with onions are given for diarrhœa. Several of the Bauhinias yield a partially soluble gum, which is known as Sem or Semla gum. The young buds of **Bauhinia tomentosa**, *Linn., Bot. Mag., t.* 5560; *Rheede Hort. Mal. i., t.* 35, Sampage (*Can.*), are said by Ainslie to be prescribed by native practitioners in Southern India in dysenteric affections; they are mildly astringent. According to Rheede, a decoction of the root-bark is administered on the Malabar Coast in cases in which the liver is inflamed.

Chemical composition.—The kino, prepared from the bark of *B. racemosa*, was practically soluble in water with a red colour, and afforded to ether one per cent. of crystalline pyrocatechin. About half the drug consists of tannic acid giving a dirty green precipitate with ferric salts; when thrown down by neutral lead acetate the precipitate holds 35 per cent. of PbO, and the basic salt 55 per cent. Shaken up in powder with rectified spirit, about 7 per cent. of extract was obtained answering to glucose; while by treating the filtrate from the lead compound with hydrogen sulphide and filtering, as much as 17 per cent. of glucose was separated. The large amount

(13·3 per cent.) and causticity of the ash point to the fact that, different to other kinos, much of the tannic acid is in combination.

MIMOSA PUDICA, *Linn.*

Fig.—*Bot. Rep., t.* 544. Sensitive plant (*Eng.*), Sensitive commune (*Fr.*)

Hab.—Hotter parts of India, probably introduced from Tropical America.

Vernacular.—Lajálú (*Hind.*), Làjak (*Beng.*), Lájri (*Mar.*), Total-vadi (*Tam.*), Mudugudavare (*Can.*).

History, Uses, &c.—A native of Brazil long naturalized in India, and called in Sanskrit Khadiri and Anjalikarika, *i.e.*, joining the hands in worship or prayer. Mír Muhammad Husain states that it is much valued as a medicine by the Indians, and is considered to be resolvent, alterative, and useful in diseases arising from corrupted blood and bile. The juice is also applied externally to fistulous sores. He says that at the time of the *Pakhad Nakshatra*, the Indian Mahometans resort to the places where the plant grows, wash, and offer some sweets and burn incense; they then gather the plant, taking care that the shadow of the gatherer does not fall upon it, and dry it in the shade: when the moon is again in the same Nakshatra, they powder it and mix about four grains with cow's milk, and say the following *mantra* seven times before they take it :—

*بسم الله دولہا امرت دولہا سنگہ ادان نمو نمو بشواد

The medicine is taken every day for three weeks in the same manner,—in the first week all bilious diseases and fevers are supposed to be cured, in the second piles, jaundice, &c., and in the third leprosy, scabs and pox.

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* This *mantra* appears to be a farrago of Arabic, Persian and Sanskrit of doubtful meaning.

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Ainslie, noticing its use in Southern India, says:—"A decoction of the root of this plant is considered on the Malabar Coast to be useful in gravellish complaints. The Vytians of the Coromandel side of India prescribe the leaves and root in cases of piles and fistula: the first are given in powder, in a little milk, to the quantity of two pagodas' weight or more during the day." (*Mat. Ind.* II., 432.) In the Concan the leaves are rubbed into a paste and applied to hydrocele; and their juice with an equal quantity of horse's urine is made into an *anjan* which is used to remove films of the conjunctiva by setting up an artificial inflammation. In what is called *cracked pot cough* by the natives, the root is directed to be gathered on Sunday, wrapped in Bhojpatra (bark of *Betula Bhojpatra*), and tied with a string made of silk of five different colours; this packet is to be kept in the sun and tied upon the patient's neck at ebb tide.

This is the commonest kind of sensitive plant, and is too well known to require description; it has an acid and pungent taste; the root is fibrous.

Theophrastus (H. P. IV. 3.) mentions a sensitive plant called ὑλημα with pinnate leaves and spinous branches of which he says *εαν τις ἁφηται των κλονιων, τα φυλλα, ωσπερ αφαναινομενα συμπιπται, ειτα μετα τινα χρονον αναβιωσκει και θαλλει.*

Chemical composition.—The tapering thin roots of *M. pudica* contain 10 per cent. of tannin of such a nature as to form a good black ink with salts of iron. The ash of the roots amounts to 5·5 per cent.

ENTADA SCANDENS, *Benth.*

Fig—*Scheff. in Nat. Tijdschr. Ned. Ind. xxxii.*, 99, *t.* 16—18; *Rheede, Hort. Mal. viii.*, *t.* 32—34; *ix.*, *t.* 77. *Syn.*—Entada pursætha.

Hab.—Cosmopolitan in the tropics. The seeds.

Vernacular.—Garambí, Gardul (*Mar.*), Gila-gach (*Beng.*), Parin-kaka-vully (*Mal.*), Suvali-amli (*Guz.*), Pangra (*Sikkim*), Takdokhyen (*Lepcha*); the seeds, Pilpápra (*Guz.*), Gila (*Beng.*).

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Description, Uses, &c.—The plant is a gigantic climbing shrub, remarkable for its legumes, which are several feet long, 4 to 5 inches broad; and surrounded with a thick, very firm, polished entire rim, which is found to remain like a picture-frame when the less durable jointed body of the legume has disappeared. The joints are 10 to 30, one-seeded, ligneous, swelled in the centre, transversely furrowed, greenish ash-colour when ripe. The seeds are more or less heart-shaped, flattened, about 2 inches in diameter, with a shining brown testa, which is 1-16th of an inch thick, and very tough and horny. It encloses two large, equal cotyledons which adhere to it. The radicle is patelliform, and lodged at the umbilicus of the seed. The substance of the cotyledons is white and insipid. When a thin section is cut and a drop of water placed upon it, the water immediately becomes milky, and the opacity of the section is much diminished. Under the microscope this is seen to be due to the escape of oil globules and granular matter from their containing cells. The properties of the seeds do not appear to have been tested in European practice; among the natives they have the reputation of being emetic, and a paste prepared from them is applied to glandular swellings. Dalzell and Gibson (*Bombay Flora*, Part I., p. 84), say:—"An infusion of the spongy fibres of the trunk is used with advantage for various affections of the skin in the Philippines, where it is called 'Gogo' (Adams); the seeds are eaten roasted in Soonda." Horsfield in his list of Javanese plants states that this plant is used as an emetic by the Javanese, but he does not say which part of the plant is employed. Ainslie notices it under its Javanese name of Gandoo, and remarks that it is the Mahapus-woela of the Cingalese, and the Faba marina of Rumphius. The Lepchas and other hill tribes use the seeds as a soap to wash their hair, and as a food after they have been roasted and soaked in water.

Chemical composition.—The seeds have been examined by Moss (1887), who found 7·03 per. cent. of a neutral, turbid, pale yellow, viscid oil, which was not rendered clear by heat. (Braunt gives the yield at about 30 per cent.)

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Alcohol extracted 4·6 of a reddish gummy hygroscopic extract; chloroform 0·435 of a pale yellow hygroscopic extract. Neither of these extracts yielded any alkaloid or glucoside, nor did a proof-spirit extract, or the extracts of the integuments, but an aqueous extract gave evidence of the presence of saponin. (*Pharm. Journ., Sept.* 17*th*, 1887.)

ACACIA, Several species.

Fig.—*Bentl. and Trim., t.* 94—95. Gum Arabic (*Eng.*), Gomme Arabique (*Fr.*). From African and Arabian acacias.

Vernacular.—Gum Arabic, Maswai-gond, Maklai-gond (*Bomb.*).

Extract of the pods, Ákákia (*Ind., Arab.*).

History, Uses, &c.—There appears to be no mention of gum Arabic in Sanskrit works. It was known from a very early date in Egypt as Kami. Dioscorides calls it κόμμι in his chapter περὶ ἀκακίας. Pliny mentions Gummi several times.* Arabic and Persian writers describe it under the name of Samgh-i-Arabi. The author of the Makhzan gives the following description of what it ought to be:—"The gum of the tree called Ammughilán or Mughilán (Acacia) of a yellowish white colour, shining, and perfectly soluble in water, forming a clear sticky solution." Gum is used medicinally by the Mahometans, who consider it to be pectoral, strengthening, and emollient. An account of the history of gum in Europe, and its production in Northern Africa will be found in the *Pharmacographia.* The gum Arabic of Bombay, known in European commerce as East India gum, is an imported article, and is brought from Aden and the Red Sea ports, no part of it being the produce of India. Two kinds are met with in that market, *viz.*, "*Maklai,*" in large round tears or vermicular pieces, white, yellow, or reddish, much like gum Senegal, but more fissured, (it derives its name from the port of Makalla), and "*Maswai,*" in angular fragments and vermicular pieces, fis-

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* Plin. 13, 20; 24, 64, 67.

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sured, white, yellow or reddish, which derives its name from the port of Massowa. Both of these are good soluble gums, and if carefully sorted not much inferior to Kordofan gum. Both are exported to Europe, and form the East Indian gum of commerce. About 15,000 cwts. of these gums were annually imported into Bombay, but since the war in the Soudan the imports have much decreased.

Akakia, according to the best Arabic and Persian authorities, is an extract prepared from the juice of the Karaz. This is the fruit of the *Acacia nilotica* of Delile (*Fl. Ægypt., t.* 963), the *Acacia vera* of Vesling (*Œgypt., p.* 9, *Icon.*), and is called by the Egyptians "Sant."

It is the ακανθος of Theophrastus (iii., 4; iv., 3; vi., 1) and the Acanthus of Virgil, who speaks of "baccas semper frondentis acanthi" in allusion to the globular inflorescence (Georg. ii., 119).

Pliny (24, 67) says that "the juice is left to thicken in the pods, which are steeped in rain water for the purpose, and then pounded in a mortar; after which the juice is extracted by means of presses. It is then dried in the sun, and when dry divided into tablets." It is considered to be cold and dry, astringent, styptic, and tonic, and is used internally and locally in relaxed conditions of the mucous membranes, also as a collyrium in purulent conjunctivitis and chronic congestion of the vessels of the conjunctiva. Applied as a lotion it is said to improve the complexion. With white of egg it is a good application to burns and scalds, powdered it arrests hæmorrhage; in short, it is used in all cases in which an astringent is indicated.

Description.—It is heavy, hard, and has an agreeable odour, small fragments held between the eye and the light should be of a bottle-green colour, but some samples have a reddish tinge like the glass of which hock-bottles are made; when seen in bulk it appears black. The taste is sweet, astringent and mucilaginous. Placed in cold water it soon disintegrates, forming a mucilage in which floats a quantity of olive-green or brownish-green matter; after filtration the mucilage is similar in colour to that of gum arabic.

Commerce.—Akákia is imported from the Red Sea ports, and is kept by all Mahometan druggists; it occurs in bladders containing 5 to 6 ounces each.

Chemical composition of Gum.—The lævorotatory gums are principally potassium, magnesium, and calcium salts of arabic or allied acids; they contain from 12 to 18 per cent. water, and yield 2·7 to 3·0 per cent. of ash consisting almost wholly of carbonates of these metals. Arabic acids ($C^{12} H^{22} O^{11}$) has been isolated from the so-called East Indian gum. (*O'Sullivan.*) For the method of preparing it see (*Watt's Dict. of Chem. by Morley and Muir*, ii., 295.) When slowly dried out of syrupy solutions, on glass plates, it is a brittle, transparent, colourless, glassy body, soluble in water. During desiccation, especially if a little mineral acid be present, the acid is frequently converted into the meta modification. Solutions of arabic acid are strongly acid to litmus paper, and have a sharp acid taste; they completely neutralise solutions of the alkalies and alkaline earths, and decompose carbonates. The salts of the alkaline earths are precipitated out of solution by alcohol; those of the alkalies are not precipitated under the same conditions, but yield peculiar milky or opalescent solutions from which arabic acid, with some of the alkaline salt, is precipitated on the addition of stronger acids. $Ba\,SO^4$, PbS, and other sulphides, and some hydrates precipitated in solutions of arabic acid, cannot be filtered out, but pass, in greater part, through the filter. Gum arabic prevents the precipitation of the alkaloids by phosphomolybdic acid, potassium-mercury iodide and tannin. (*Lefort et Thibault.*) These are properties common to all the gum acids. The defining characters of arabic acid are its optical activity, *viz.* $[a]\,j = -26^\circ$ to 28°, for solutions containing 5 to 6 grams dry substance in 100 c.c., and the composition of its neutral barium and calcium salts; in the dry state, the former contains 6·0 per cent. BaO and the latter 2·28 per cent. of CaO. (*O'Sullivan.*) Solid gum roasted with oxalic acid

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yields metagummic acid (*Frémy*); this is dissolved by solutions of the alkalies and alkaline earths with the reproduction of arabic acid. (*Rhem. in Ding. Pol. Journ.* 216, 539.) Gum even in small quantities injected into the blood diminishes the elimination of urine; large doses completely stop the secretion, with a marked increase of blood pressure (*Richet et Montard-Martin, Compt. Rend.* 90, 88.) Gums vary much in the character of the solutions they yield, some give a thin syrupy solution, others a thick and jelly-like one; this is due to the varying proportion of the acid naturally converted into the meta modification—the gums which yield the thinnest solution are those which contain the greatest amount of ash. Gums from the same source have not always the same optical activity. (*Watt's Dict. of Ch. by Morley and Muir*, ii., 296.)

SUBSTITUTES FOR GUM ACACIA.

We are indebted to Mr. J. G. Prebble of Bombay for the following:—

The exports of Indian gums for use as substitutes for gum arabic, have during the last few years obtained considerable proportions, and there is every probability of a steady increase due to the improvements in communication between the ports and the interior of the country, and the supplies promise to rival in the near future the large exports of gum from Senegambia. The gums here described include the majority and the most important of those known to be yielded by Indian trees; and most of them have been personally collected by the writer; a few have been kindly forwarded by Mr. Duthie of Saharanpur and some by Mr. Cameron of the Lal Bagh, Bangalore. Nearly all the gums have been examined under the microscope, and in connection with this subject some account should perhaps be given of the recent interesting researches of Beijerinck and Wiesner. All gums were formerly supposed to be the dried mucilaginous sap secreted by a natural or physiological process in the life of the plants yielding them. It was first clearly shown by Mohl, that, in the case of tragacanth, the gum is produced by a metamorphosis of the cell membrane,

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and that it is not merely the dried secretions of the plant. The investigations of other observers also demonstrated that cherry and some other gums were formed by a similar process, but no information was obtained of the causes which led to these metamorphoses. The observations of Beijerinck and of Wiesner, however, point to the conclusion that in at least several instances gum is formed by a pathological process brought about by the influence of a fungus, or of a peculiar ferment allied to diastase and termed by Wiesner a "diastatic enzyme," but differing from the ordinary members of the group in that, whilst it converts starch into dextrine, it produces no sugar reducing Trommer's reagent. The diastatic character of the gum was inferred from its behaviour in limiting or preventing the iodine reaction on starch dough. Beijerinck found that by inserting a portion of gum under the edge of a wound in the bark, the formation of gum was induced. The observation that heated or long boiled pieces of gum would not produce this effect, and that wounds made in the bark did not produce gum unless a portion was first introduced into it, led him to suppose that the formation of gum was due to the presence of bacteria or other living organisms. On microscopical investigation it was found that only those pieces of gum that contained spores of a highly organised fungus belonging to the Ascomycetes, had the power of conveying the gum disease or gummosis. The fungus producing the gummosis of species of acacia of Africa has been named *Pleospora gummipara*, Oudemans. Another fungus, *Coryneum Beijerinckii* causes the gummosis of the Amygdalæ. Beijerinck believes that the fungus produces a fluid of the nature of a ferment, which penetrates the adjacent structures, since the disease extends beyond the parts in which any trace of the fungus can be detected. This ferment he believes to act on the cell walls, starch granules, and other constituents of the cells, transforming them into gum, and [*] even changing into gum the fungus itself. In all the gums examined by the writer, fungus spores were observed, and in many cases gonidial forms and

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[*] *Pharm. Journ.*, 3-14-661 and 3-16-285.

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hyphæ. These gonidial forms and hyphæ vary considerably in the same genera. The hyphæ and gonidia found in the gum of *Acacia modesta* from the Punjab differ in shape and size from the same forms observed in *Acacia Farnesiana* from Bombay, and the forms occasionally met with in *Acacia arabica* differ from both. It seems therefore improbable that only one species of fungus produces the gummosis in the tribe acacia as stated by the above observers. That gum has the power of converting starch into dextrine, is readily proved by its action on starch paste, but the statement of Wiesner that whilst it converts starch into dextrine, it produces no sugar reducing Trommer's reagent, I am unable to confirm. In several experiments performed with different gums, a reducing sugar was in every instance abundantly produced, and it is probable that the action of gum on starch is similar to that of diastase, when the hydration products are dextrine and maltose, the proportions of which vary according to the conditions of the experiment, especially as regards the temperature employed. With the aid of iodine the gradations in the transformation or hydration of the starch may be easily followed. When the gum and starch paste has been standing a short time, iodine gives a blue or violet coloration, after a longer period some shade of crimson, the erythrodextrine of Gruber, and finally the mixture ceases to give any reaction when the conversion of the starch is then complete. Gum which is permeated with fungus, as that derived from *Acacia Farnesiana*, has a more rapid action on the starch paste than a gum free or nearly so from fungus as that from *Anogeissus latifolia*. *Acacia Farnesiana* gum will convert its own weight of starch, made into paste, in two or three days at the ordinary temperature of Bombay, about 80° F. At a higher temperature the transformation is quicker.

With regard to the behaviour of gums to reagents, too much reliance must not be placed upon the reactions, as gums from the same tree often give different results. It is believed, however, that they will often furnish useful indications of the source of a gum, taken in conjunction with their physical and sometimes microscopical characters. The reagents employed are those which have been found most useful for comparative purposes. All the gums, with the exception of the paler samples of *Acacia arabica,* and a gum said to be yielded by *Acacia leucophlœa,* are gelatinized by basic acetate of lead.

Gums or so-called gums from the following plants have been examined :—

Feronia Elephantum.—The gum occurs in small, irregular or rounded tears, varying in colour from reddish brown to pale yellow or colourless. The paler samples dissolved in water form a thick, tasteless and colourless mucilage. The solution is precipitated by both neutral and basic acetate of lead and by ferric chloride, but not by borax. This is one of the most valuable of the Indian gums, and is a good substitute for gum arabic.

Ægle Marmelos.—A small sample of this gum received from Saharanpur was in reddish brown, transparent angular fragments. It is quite insoluble in water, but dissolves in strong alcohol; it is therefore a resin. A small quantity of exudation collected from a tree in Bombay was also a resin. The solution in alcohol is of a yellow colour with a greenish fluorescence.

Melia Azadirachta.—The gum occurs in large tears, cracked and fissured on the surface, or in vermiform or stalactiform pieces of a pale yellow or amber colour, readily dissolving in water, forming a good, pale-coloured mucilage. The solution is gelatinized by ferric chloride and basic acetate of lead, but not by borax or neutral acetate of lead.

Cedrela Toona.—Some gum gathered from a tree on the Nilgiris was in transparent stalactiform masses of a yellowish brown colour, and smooth and polished on the surface. It forms a thick mucilage with a large volume of water. The mucilage is gelatinized by basic acetate of lead, but is unaffected by the neutral acetate, ferric chloride or borax. After keeping the gum about a year and again treating with water it was found to be much less soluble, the gum swelling into a gelatinous mass.

Swietenia Mahagoni yields a gum that often runs down the side of the tree, drying up into brittle, white, shining fragments, which however become yellow on keeping. It dissolves readily in water, forming a weak dark-coloured mucilage, which freely reduces Fehling's solution; is precipitated by acetate of lead, gelatinized by the basic acetate and by ferric chloride, but not by borax.

Chloroxylon Swietenia.—A sample of this gum received from Bangalore was in dark reddish-brown tears and stalactiform pieces. It swelled up in water, forming a gelatinous mass, hardly any dissolving.*

Anacardium occidentale yields large quantities of gum, mostly in stalactiform masses, varying in colour from yellow to deep reddish brown. It dissolves readily in water, but forms a slightly glairy, more or less turbid mucilage. The turbidity is due to the presence of a small quantity of a yellowish oily body, which may be detected under the microscope. It is probably the occurrence of this oil in the gum that renders it obnoxious to insects. A mucilage of the yellowish gum is unaffected by neutral acetate of lead, perchloride of iron, bichromate of potash, molybdate of ammonia or borax, but it very freely reduces Fehling's solution, and is gelatinized by basic acetate of lead. The mucilage of the dark reddish brown gum is blackened by bichromate of potash and by ferric chloride, but is not gelatinized. It is precipitated by molybdate of ammonia.

Odina Wodier yields an abundant supply of gum in large tears and stalactiform masses, of white, yellow or amber colour; brittle and friable from the presence of numerous minute cracks. With water it forms a glairy mucilage, which is turbid from the presence of a small quantity of oil recogniz-

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* A sample from another source was more soluble (see p. 339), but the solution had scarcely any adhesive power.

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able under the microscope. The mucilage slightly reduces Fehling's solution, is gelatinized by basic acetate of lead and ferric chloride, but not by neutral acetate of lead nor by borax.

Spondias mangifera.—The gum exudes in stalactiform pieces of a yellowish or reddish-brown colour and with a smooth shining surface. It forms a gelatinous mucilage with a large volume of water. The mucilage is precipitated by acetate of lead, gelatinized by the basic acetate and by ferric chloride, but not by borax.

Poinciana regia yields a gum in irregular granular or warty tears of a yellowish or reddish brown colour soluble in water, forming a thick opalescent mucilage. The solution is gelatinized by basic acetate of lead and ferric chloride, but not by the neutral acetate nor by borax. Fehling's solution is slightly reduced. The gum contains a large quantity of oxalate of lime. The surface of some of the tears is of an opaque yellow colour; this portion consists largely of beautiful sphæro-crystals of oxalate of lime, closely resembling in formation the sphæro-crystals of inulin. On moistening this gum with water a cloud of small crystals often separates, and the sphæro-crystals attempt to arrange themselves into bundles of acicular crystals.

Bauhinia purpurea yields an inferior gum that swells up in water, forming a gelatinous mass, very little dissolving.

Bauhinia variegata.—A sample of the gum received from Bangalore was in irregular broken tears of an amber colour, but distinctly opalescent. It is not completely soluble in water, but forms a milky mucilage due to the presence of starch. Examined under the microscope the starch is seen to be composed of round granules, some of which are fused together into masses. Many of the granules do not give a well-defined cross with polarized light, and appear to be worn and degraded. Three-celled cask-shaped gonidia with a hyaline extremity, and sphæro-crystals of oxalate of lime are also met with.

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Prosopis spicigera.—The gum, which is unusually friable, occurs in small angular fragments of a yellowish colour, more or less deep, sometimes in large ovoid tears about two inches long, of an amber colour internally, but having a frosted or candied appearance externally from the presence of numerous minute cracks which cause the tears to crumble under pressure. With water it forms a rather dark coloured tasteless mucilage of about the same viscosity as gum arabic. The solution is precipitated by the normal acetate of lead and gelatinized by the basic acetate, also by ferric chloride, borax and alkaline silicates. It rather freely reduces Fehling's solution. This is a valuable gum, and appears to resemble, except in its behaviour to reagents, the Mezquite gum of Mexico and Texas, which is now coming into use in America.

Acacia Farnesiana yields gum freely in the form of spheroidal tears and stalactiform masses ranging in colour from pale yellow to dark-reddish brown. The gum collected in the neighbourhood of Bombay and at Poona in the Deccan is only slightly soluble. On stirring up with water it partially dissolves, but after remaining a short time undisturbed it gelatinizes. The strained mucilage is precipitated or gelatinized by neutral and basic acetate of lead, perchloride of iron, and silicate of soda, but not by borax. It slightly reduces Fehling's solution.

Under a high power of the microscope, the gum is seen to be thickly interwoven with the minute hyphæ and fructifications of a fungus probably belonging to the Ascomycetes. The fungus is composed of a brown parenchyma containing oil globules, and bearing oval-shaped gonidia divided into two cells by a transverse septum. The gonidia are supported on hyaline stems (sterigmata) arising from the hyphæ. *Debris* of cells containing monoclinic crystals and interwoven with fungi are occasionally met with.

Acacia arabica yields an abundant supply of gum, mostly exuding in the hot weather. It forms tears and stalactiform masses, the latter sometime of large size when ob-

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tained from trees that have been wounded. The colour varies from pale yellow to deep reddish brown or black. It is usually quite soluble in water, forming rather a weak mucilage. The solution is not gelatinized by either neutral or basic acetate of lead, but it slightly reduces Fehling's solution, and is darkened in colour by ferric chloride and gelatinized by borax. The deep reddish brown or black gum which has hung long on the tree contains tannin, and is precipitated by basic acetate of lead; forms an inky colouration with ferric chloride; a deep brown with bichromate of potash, and a red with molybdate of ammonia. It freely reduces Fehling's solution. This dark-coloured gum is not always readily soluble in water, but leaves a gelatinous portion undissolved. In connection with the solubility of this gum, the observations of J. H. Maiden* on the *Eucalyptus Kinos* are of interest. He found that the kino when freshly gathered is quite soluble, but that by exposure on the tree to sun and air the gum becomes black and insoluble. This he regards as due to the conversion of the tannin into phlobaphenes, and in those that contain arabin the tendency to insolubility is probably enhanced by the partial conversion of that substance into metarabin. The gum is usually free from fungus, but I have met with three-celled, somewhat cask-shaped gonidia, with a small hyaline portion at one end, the remains of the stem.

Large quantities of this gum, collected chiefly in the Behars and Central Provinces, are exported from Bombay. It forms the bulk of the Amrad,† Amraoti or Oomrawatti gum of the Bombay gum merchants.

Acacia leucophlæa—A sample of this gum received from Bangalore was readily soluble in water, forming a good,

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* Botany Bay, or Eucalyptus Kino; by J. H. Maiden, *Pharm. Journ.*, [3], XX., p. 221.

† This word Amrad is probably a corruption of the Arabic hamrâ, red, and is a name applied to all dark-coloured gums. The word appears to have been first used in connection with African gums. The Acacia arabica trees in Senegal are called Red gum trees; see also *Pharm. Journ.*, 3-19-1.

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thick, pale-coloured mucilage. The solution is gelatinized by borax, but is unaffected by either neutral or basic acetate of lead or perchloride of iron.

Acacia Catechu.—The gum occurs mostly in spheroidal tears of a yellow or brown colour, freely soluble in water, forming a thick pale-coloured mucilage not precipitated by neutral acetate of lead, but gelatinized by basic acetate of lead, ferric chloride, and borax. It freely reduces Fehling's solution.

Acacia modesta.—The gum occurs mostly in very small tears or angular fragments with some vermiform pieces marked with waved transverse lines. It is translucent and of a yellowish colour; very soluble in water, forming a good pale-coloured mucilage. With basic acetate of lead and ferric chloride it forms a jelly, but not with borax; with neutral acetate of lead a faint precipitate or cloudiness, and a slight reduction with Fehling's solution. The gum is sent to Bombay from Northern India, and is classed by the gum merchants as Amritsar gum.

Albizzia procera.—The trunks of trees growing in the neighbourhood of Bombay are often covered with numerous granular or warty masses of gum about half an inch in diameter; occasionally the gum exudes in small tears and vermiform pieces. It is of a reddish brown colour, transparent and polished in appearance when fresh, but becomes dark and opaque on keeping. The freshly exuded gum completely dissolves, yielding a thick, slightly gelatinous mucilage, but the dark, opaque gum is imperfectly soluble. The mucilage is gelatinized by both neutral and basic acetate of lead and by ferric-chloride, but not by borax. It rather freely reduces Fehling's solution. The gum is permeated with the hyphæ of a fungus, and often contains *debris* of cells interwoven with hyphæ. Sphæro-crystals of calcium oxalate are frequently met with.

Albizzia stipulata yields a tough, dark-coloured gum, which swells up in water into cartilage-like masses, very little

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dissolving. The soluble portion freely reduces Fehling's solution, is gelatinized by basic acetate of lead, but not by the neutral acetate nor by borax; with ferric chloride it darkens in colour, but is not gelatinized.

Albizzia Lebbek.—The gum exudes mostly in stalactiform masses and varies in colour from light to deep reddish brown. It is translucent and has a smooth polished surface. It forms a slightly gelatinous mucilage with a large volume of water; sometimes it is imperfectly soluble, and leaves a gelatinous portion undissolved. The mucilage is gelatinized by basic acetate of lead and by ferric chloride, but not by the neutral acetate of lead nor by borax. It slightly reduces Fehling's solution.

Albizzia odoratissima.—The gum forms large transparent tears of an amber colour; free from cracks internally, but superficially fissured. In water it swells up into tough colourless masses, very little dissolving.

Pithecolobium dulce yields a gum usually in spheroidal tears, about half an inch in diameter, of a deep reddish brown colour, transparent, and with a polished surface. It is freely soluble in water, forming a thick brown mucilage. The solution is unaffected by neutral acetate of lead, but is gelatinized by the basic acetate, ferric chloride, and borax. It freely reduces Fehling's solution.

Pithecolobium Saman yields a very inferior gum, forming irregular tears and vermicular pieces with waved transverse ridges. It is of a soft and tough consistence, and swells up in water into tough cartilage-like masses. On keeping, it turns a deep reddish brown or black colour.

Anogeissus latifolia.—The gum usually occurs in rounded or vermicular pieces, sometimes in elongated tears. Colour ranging from amber-brown to pale yellow or colourless; the surface is roughened and opaque; it has a glassy fracture, and is quite transparent internally and free from cracks. The gum

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darkens in colour by keeping through the monsoon season, and becomes agglutinated into masses. With water it forms a nearly colourless mucilage, quite colourless with the finer qualities of the gum, possessing a faint characteristic odour, and about double the viscosity of gum arabic treated with the same proportion of water. The solution is gelatinized by basic acetate of lead and by borax, but is unaffected by ferric chloride or neutral acetate of lead. This is a very valuable gum, and may be obtained in almost any quantity nearly free from admixture with other gums, as it possesses well marked physical characters which render it readily distinguishable. Its dull white, roughened surface and glassy fracture free from cracks distinguish it from all other gums. The finer qualities are well suited for use in pharmacy, and for the preparation of emulsions it is unrivalled. As it possesses about double the viscosity of gum arabic, one part of this gum should be used where two parts of the former are ordered.

This gum is now largely exported, and forms the bulk of the Ghátí* gum of the Bombay gum merchants.

Terminalia belerica produces a gum in tears and vermicular pieces of a dark brown colour with a smooth surface, free from cracks. When placed in water it swells up to a tough gelatinous mass, very little dissolving. The gum contains crystals of calcium oxalate in dumb-bell-like forms, sphæro-crystals and groups of fine crystalline particles.

Aleurites moluccana yields in Bombay a partially soluble gum of a yellowish or brown colour. The solution is gelatinized by neutral and basic acetate of lead and by borax but not by ferric chloride. The gum is permeated with the hyphæ of a fungus.

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* The Marathi adjective Ghátí signifies "relating to the Desh or country above the Sayhadri range."

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Tabular View of the Solubility and Reactions of Indian Gums.

A—Arabic-like gums soluble in water.

	Neutral Acetate of Lead.	Ferric Chloride.	Borax.
Acacia arabica	....	....	Gelatinized.
„ leucophlœa (?)	....	....	Gelatinized.
Anogeissus latifolia	....	....	Gelatinized.
Acacia modesta	Precipitated.	Gelatinized.	....
Feronia Elephantum	Precipitated.	Gelatinized.	....
Swietenia Mahogani	Precipitated.	Gelatinized.	....
Acacia Catechu	....	Gelatinized.	Gelatinized.
Pithecolobium dulce	....	Gelatinized.	Gelatinized.
Melia Azadirachta	....	Gelatinized.	....
Prosopis spicigera	Precipitated.	Gelatinized.	Gelatinized.

B—Gums readily dissolving in water but forming a more or less turbid mucilage from insoluble suspended substances.

	Acetate of Lead.	Ferric Chloride.	Suspended substance.
Anacardium occidentale.	....	....	A yellowish oil.
Odina Wodier	....	Gelatinized.	A yellowish oil.
Bauhinia variegata	Precipitated.	Gelatinized.	Starch granules.
Poinciana regia	....	Gelatinized.	Calcium oxalate in sphæro-crystals.

None of these Gums are gelatinized by Borax.

C—Gums incompetely soluble and forming a more or less gelatinous mucilage with a large volume of water.

	Neutral Acetate of lead.	Ferric Chloride.	Borax.
Cedrela Toona	....	....	....
Albizzia Lebbek	....	Gelatinized.	....
Acacia Farnesiana	....	Gelatinized.	....
Albizzia procera	....	Gelatinized.	....
Spondias mangifera	Precipitated.	Gelatinized.	....
Aleurites moluccana	Gelatinized.	....	Gelatinized.

D—Gums swelling up into a gelatinous mass, very little dissolving.

Albizzia odoratissima.
Albizzia stipulata.
Bauhinia purpurea.
Terminalia belerica.
Chloroxylon Swietenia.

Commerce.—Indian gums are almost entirely exported from Bombay. The exports and value for the last three years of gums of Indian production, not including those imported from African and other ports, were as follows:—

1886 and 1887.		1887 and 1888.		1888 and 1889.	
Cwt.	20,895	Cwt.	31,826	Cwt.	55,192
Rs.	7,93,934	Rs.	14,13,511	Rs.	24,05,131

ACACIA ARABICA, *Willd.*

Fig.—*Roxb. Cor. Pl., t.* 149; *Bedd. Fl. Sylv., t.* 47. Babool tree (*Eng.*), Acacia d'Arabie (*Fr.*).

Hab.—India, Arabia, Africa. The bark.

Vernacular.—Bábul, Kikar (*Hind.*), Kuruveylam (*Tam.*), Bábhúl (*Mar.*), Bábul (*Beng.*), Baval (*Guz.*), Karijali (*Can.*).

Description, Uses, &c.—This tree is the Vabbula of Sanskrit writers, who mention the use of the young leaves and pods as an astringent in diarrhœa, and of a decoction of the bark as an astringent lotion. The bark is powerfully astringent, and as a substitute for Oak bark it is used in the Government hospitals and dispensaries in India. Externally a strong decoction of it is a useful astringent application to ulcers. The gum has already been noticed in the article upon substitutes for gum arabic. Babul bark is hard and woody, of a rusty brown colour, having a tendency to divide into several layers. The external surface is rugged and fissured longitudinally, the internal smooth and fibrous; taste astringent and mucilaginous.

The astringent bark of this and several other species of Acacia* is used in India to assist in the preparation of spirit from sugar and palm juice by precipitating the albuminous substances in the liquor and facilitating fermentation. Spirit thus prepared is noticed by Ainslie as the *Puttay chárágum* or bark spirit of the Tamils.

Chemical composition.—Kay and Baston (*Journ. Soc. Dyers and Col.* iii., 132) by employing Proctor's modification of Lowenthal's process for estimation of tannin, found 22·44 per cent. in the pods, expressed in terms of oxalic acid. (*Allen.*) The wood contains chlorides which act upon copper when burnt, and is therefore not adapted for fuel for engines on railways.

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* *A. leucophlæa, A. ferruginea, A. Jacquemontii.*

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ACACIA CATECHU, *Willd.*

Fig.—*Roxb. Cor. Pl., t.* 175; *Bentl. and Trim., t.* 95. Catechu tree (*Eng.*), Acacia Cachou (*Fr.*).

Hab.—India. Acacia Catechu or Cutch.

Vernacular.—Khair (*Hind., Mar., Beng.*), Vodalia, Vodalam (*Tam.*), Khera-baval (*Guz.*), Kagli (*Can.*).

Catechu.—Katha, Kath (*Hind., Mar.*), Kattakambu (*Tam.*), Katho (*Guz.*).

History, Uses, &c.—Sanskrit writers under the name of Khadira mention two kinds of catechu, dark and pale, both prepared from the wood of the *Acacia Catechu,* and these two kinds are still to be found in common use. The dark acacia catechu is in flat cakes of a dark brown colour and shining fracture, or in square cakes known as box catechu. The light catechu is a porous earthy-looking substance, somewhat laminated and much more friable than the dark: it is used for chewing with betel leaves and areca nut, while the use of the dark kind is confined to industrial purposes. Dark catechu is made by evaporating a decoction of the wood until it becomes solid; in making the light kind the inspissation is stopped at a certain point, and the catechu is obtained as a deposit upon twigs which are placed in the liquid extract. The Hindus consider catechu to be astringent, cooling, and digestive, useful in relaxed conditions of the throat, mouth and gums, also in cough and diarrhœa. Externally they use it as an astringent and cooling application to ulcers, boils, and eruptions on the skin. A number of compound formulæ for its administration will be found in Chakradatta, Sarangadhara, and the Baisajya Ratnávali. Mahometan writers describe dark and light catechu, and their use in medicine for the purposes already mentioned. An account of the introduction of catechu into Europe will be found in the *Pharmacographia.* Other kinds of the drug which are imported into India by sea will be found described in the article upon Gambier. The gum of *A. Catechu* has been noticed in the article upon *Substi-*

tutes for gum arabic. In the Concans the juice of the fresh bark is given with Asafœtida in hæmoptysis, and the flowering tops with cummin, milk and sugar in gonorrhœa.

Chemical composition.—In addition to a large proportion, 45—55 per cent. of a variety of tannin (catechu tannic acid), cutch contains 30 to 40 per cent. of catechu, which is deposited on cooling a boiling aqueous solution. Cutch should not yield more than 5 per cent. of ash. (*Allen.*)

Catechu, $C^{19} H^{18} O^{8}$, is a name given to various compounds contained in catechu or Terra Japonica, which is extracted by boiling water from the fruits or twigs of a variety of plants; catechu from twigs and unripe pods of *Acacia* (*or Mimosa Catechu*); Gambier catechu from *Nauclea* (or *Uncaria*) *Gambier*; and Indian catechu from some Acacia.

Catechu tannic acid has the formula $C^{21}H^{18}O^{8}$ or $C^{38} H^{34} O^{15}$ (?), and may be extracted from catechu by water: it is also formed when catechin is alone heated to 130° C., or with water to 110° C., or by boiling with alkalies. It occurs as a dark reddish brown powder, which oxidises in air. It gives a greyish green precipitate with ferric chloride, and does not precipitate tartar emetic. Its aqueous solution is precipitated by gelatine, albumen and dilute sulphuric acid. (*Watt's Dict. Chem., Morley and Muir's edition.*) For further particulars the reader is referred to the *Pharmacographia*; and for tests of purity, &c., to Allen's *Commercial Organic Analysis,* Vol III., Part I.

Commerce.—Acacia catechu for use with pán-supári is largely prepared about Surat. Value, Rs. 20 per maund of 37½ lbs. Cutch fetches from Rs. 4 to 5 per maund, and is prepared in many parts of India by wild forest tribes.

KHERSAL OR KHAIRSAR.—From the wood of *Acacia Catechu* is obtained a substance which we have not seen any notice of in works on Indian Materia Medica. Khersal, or *natural catechu,* is obtained from cavities in the wood, and occurs in small irregular fragments like little bits of very pale catechu mixed with chips of reddish wood. This drug is collected by men who split firewood, and fetches a high price, as it is only

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occasionally met with; it has a sweetish astringent taste, and under the microscope is seen to be composed of minute needle-shaped crystals. When placed in water the colouring matter of the particles of wood mixed with the drug colour the water red, but the khersal remains undissolved; in boiling water it is completely soluble, but is thrown down in conglomerate masses of small needle-shaped crystals upon the water cooling; it is also soluble in rectified spirit, and is deposited in the same form on the spirit evaporating. In native practice this substance is valued as a remedy in relaxed conditions of the throat.

A similar substance has been brought to our notice by the Conservator of Forests for Malabar. It is a yellow crystalline deposit found in the wood of the Poon spar (*Callophyllum tomentosum*).

KATHBOL—Is a mixture of catechu and myrrh, which is frequently given to women after confinement as a tonic, and to promote the secretion of milk.

ACACIA PENNATA, *Willd.*

Fig.—*Bot. Mag.*, *t.* 3408.

Hab.—India. The bark.

Vernacular—Shemb (*Mar.*), Biswúl (*Hind.*), Arar (*Can.*).

Description, Uses, &c.—A scandent shrub; prickles scattered, numerous, straight, or at length recurved; pinnæ 8 to 20 pair; leaflets beyond 30 pair, narrow linear, glabrous; heads of flowers globose-panicled; legume glabrous, or reddish with fine tomentum. The bark is an article of commerce, being used to tan fishing nets at Bombay; it occurs in strips about 3 feet long. In the Concan the leaf-juice mixed with milk is given to infants who suffer from indigestion with green stools. In bleeding from the gums the leaves are chewed with cummin and sugar; they are also rubbed to a pulp and mixed with cow's milk, cummin and sugar as a remedy for scalding of the urine. The dose is 2 tolás.

Chemical composition.—The bark afforded 14·2 per cent. of aqueous extract containing 8·8 per cent. of tannin. The

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tannin gave a black precipitate with ferric chloride, and its lead salt contained one-third of its weight of oxide of lead. The powdered bark left 12·1 per cent. of ash on ignition.

Commerce.—The bark is collected in the Concan and exported to Bombay, where it fetches about Rs. 14 per 100 bundles of 7 lbs. each.

ACACIA CONCINNA, *DC.*

Hab.—India, Burmah. The pods.

Vernacular.—Sikekai, Shika (*Mar., Tam.*), Kochai, Ban-ritha (*Beng.*); Aila, Rassaul (*Hind.*), Chikaya, Gogu (*Tel.*), Sigé (*Can.*).

History, Uses, &c.—The tree is called in Sanskrit Saptala and Charma-kasa, or "skin-injurer," on account of its numerous thorns, and is common in many parts of the country. Ainslie has the following notice of the medicinal use of the pods in Southern India:—"Sheeakai is the name given by the Tamools to a long flat pod, or legume, containing separate, small, oval, dark-coloured seeds, and which is considered by the native practitioners as a most valuable medicine; in taste it somewhat resembles the soap-nut, but is more acid, less bitter, and has a singular pungency; its qualities are allowed to be deobstruent and detergent, and, I am inclined to think, expectorant; it is commonly ordered in cases of jaundice and other biliary derangements, and is besides used by the Indians like soap-nut for washing the head. The small leaves of the prickly shrub have a pleasant acidity, and are frequently put into pepper-water when it is found necessary to keep the bowels open or work off bile. The pod is usually prescribed in electuary in doses of about the size of a small walnut, every morning for three successive days." Nimmo notices the use of the pods by Hindus for making sectarial marks on the forehead. The leaves are used as an acid ingredient in food instead of tamarinds, and the bark is used in tanning.

Description.—Pod strap-shaped, straight, 3 to 4 in. by ¾ in., 6 to 10 seeded, with broad sutures, narrowed to a short

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stalk, depressed between the seeds. In the Himalayan var. *rugata* the pod is larger, 1 to 1¼ in. broad.

Chemical composition.—The pods freed from their seeds, dried without artificial heat, and powdered, had the following percentage composition:—Moisture 8·44, saponin 11·20, malic acid 12·74, resin 1·06, glucose 13·88, gum and colouring matter precipitated by subacetate of lead 21·43, substances dissolved by alkali 4·97, crude fibre 22·52, ash 3·76. In estimating the saponin by the barium hydrate method, the malic acid was precipitated with it. The total free and combined acid was estimated by precipitation with neutral plumbic acetate, the malate of lead yielding fine white crystals in a few hours. Malic acid existed in the fruits in a free state. The total free acidity found by titration with standard alkali was equivalent to 4·48 per cent. of Na HO. The saponin could be very readily estimated by boiling an infusion acidulated with sulphuric acid for two hours, and by separating and weighing the insoluble sapogenin.

Commerce.—The pods are sold in the bazars of many parts of India. Value, Re. 1½ to 1¾ per maund of 37½ lbs. They are collected largely by the Forest Department in South Canara. In 1885-86, 9 tons collected realized Rs. 555; in 1886-87, 135 tons realized Rs. 8,369; and in 1887-88, 97 tons realized Rs. 7,168.

ALBIZZIA LEBBEK, *Benth.*

Fig.—*Jacq. Ic. t.* 198; *Bedd. Fl. Sylv. t.* 53: The Siris tree (*Eng.*).

Hab.—Throughout India. The bark, leaves, and flowers.

ALBIZZIA ODORATISSIMA, *Benth.*

Fig.—*Roxb. Cor. Pl. t.* 120; *Bedd. Fl. Sylv. t.* 54.

Hab.—Throughout India.

Vernacular.—Siris (*Hind.*, *Beng.*), Siras, Chichola, Chichva (*Mar.*), Sirasala-mara, Bengha (*Can.*), Vaghe (*Tam.*), Darshana (*Tel.*), Siris, Harreri (*Guz.*).

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History, Uses, &c.—Both trees are known to the natives of India by the same vernacular names, and both are called in Sanskrit Sirisa and Kapitana, and bear the synonyms of Suka-pushpa, Suka-druma, and Suka-priya, "dear to parrots," and Mridu-pushpa, "having soft flowers." According to the Nighantas Siris has cold, tonic, and alterative properties. The author of the *Makhzan-el-adwiya* gives a detailed description of the two trees as varieties of one and the same plant, and says that he has been given to understand that the Arabs have named the tree Sultán-el-ashjár, and that the Persians call it Darakht-i-Zakariya. He states that the juice of the leaves is applied to the eyes to cure night-blindness, a decoction being at the same time given internally. A decoction of the bark is used as a mouth-wash to strengthen the gums. One masha of the powdered bark with three or four tolas of melted butter taken daily is an excellent tonic and alterative. A water is also distilled from the bark which is used for the same purposes. The flowers are supposed to be retentive of the seminal fluid. One dirhem of the powdered seeds with two dirhems of sugar-candy in a glass of warm milk taken daily is said to thicken the seminal fluid. A paste made with the seeds is applied to reduce enlarged cervical glands. The seeds are also used in the preparation of collyria. According to Baden-Powell, Stewart, and Madden **A. Julibrissin** has similar properties. In Madras the bark of *A. Lebbek* is much used by fishermen for tanning their nets. The heartwood, which is dark brown, hard, and fairly durable, is used for various industrial purposes.

Description.—The seeds are very hard and not unlike those of *Cassia Fistula*, but smaller. They have a nauseous taste with some astringency. The flowers form largish globular heads of a yellowish-white colour, those of *A. Lebbek* being larger than those of *A. odoratissima.* The bark of *A. Lebbek* has a rugged brown suber, much pitted and fissured, which can be separated in large flakes, leaving exposed a pitted irregular light red surface. The substance of the bark is light red, hard and gritty; it has an acidulous and astringent taste. The inner surface is white and woody.

Chemical composition.—The bark yields to boiling water 12 per cent. of extract, containing 7·4 per cent. of a tannin, which is coloured green by ferric salts. It yields to alcohol 14 per cent. of extract containing a resin besides the tannin. Ether removes from the powdered bark a body allied to catechin. After exhaustion with boiling water and alcohol a large quantity of red colouring matter is dissolved by caustic alkali. The ash amounts to 9 per cent.

Albizzia amara, *Boivin, Roxb. Cor. Pl., t.* 122, a tree of the Western Peninsula and Ceylon, has a medicinal reputation similar to that of *A. Lebbek* and *A. odoratissima.* For a description of the gum of these trees, see *Substitutes for Gum Arabic.* The insoluble gum of **A. stipulata** is used by the Nepalese for sizing their Daphne paper.

ROSACEÆ.

AMYGDALUS COMMUNIS, *Linn.*

Fig.—*Bentl. and Trim., t.* 99. Almond tree (*Eng.*), Amandier commun (*Fr.*).

Hab.—Europe, Central Asia. The almonds.

Vernacular—Badám (*Hind., Guz.*), Vádam-kottai (*Tam.*), Bádam-vittulu (*Tel.*), Bádámi (*Can.*), Biláti-badám (*Beng.*), Bádám (*Mar.*); Bitter almonds, Kurwe-bádam (*Hind.*), Kashappu-vadamkottai (*Tam.*), Chedu-bádam-vittulu (*Tel.*), Tikta-bádámi (*Can.*), Karú-bàdám (*Mar.*), Karavú-badám (*Guz.*).

History, Uses, &c.—Almonds are mentioned in the Book of Genesis as having been carried into Egypt from Palestine as a present by the sons of Israel; they are frequently noticed by Theophrastus[*]; Dioscorides[†] describes the use of the root, seeds and gum of the bitter almond tree as medicinal agents. Pliny also was acquainted with almonds and the almond tree (amygdala).[‡] He, as well as Celsus and Columella,

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[*] H. P. I. 18, 19, 21, 23; II. 3; VII. 12; IX. 1.

[†] Dios. i., 144. [‡] Plin. 15, 24; 23, 75.

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speak of '*nux amara*,' 'the bitter almond'; almonds were also called *Avellanæ Græcæ* and *Nuces Græcæ* by Latin writers. Much interesting information having regard to the ancient history of almonds in Europe may be found in the *Pharmacographia*. In India the almond, though probably indigenous to Cashmere and the Himalayas, does not appear to have attracted the same attention as in Europe. In some Sanskrit works it is mentioned under the name of Bádáma, the same name which it bears in Persia, where the tree is very common and the fruit much used. When the Mahometans settled in India, almonds were probably for the first time introduced into the southern and central parts of the country as an article of commerce from Persia and Afghanistan. Arabic and Persian writers on Materia Medica discuss their properties at considerable length. The uses to which they put sweet almonds are essentially the same as with us. Almonds are chiefly cultivated in the districts of Yezd and Kirman in Persia and the more temperate parts of Afghanistan.

The author of the *Makhzan-el-adwiya* mentions two kinds of sweet almond, the thick-shelled and the thin or Kaghazi (*Amandes des dames* or *Amandes Sultanes, Fr.*). He describes the method of extracting the perfumes of flowers by means of almonds placed in contact with them, and says that the oil being afterwards expressed retains the perfume. He also notices the use of the burnt shells as tooth powder, and of the unripe fruit (*Chugala*) as an astringent application to the gums and mouth. Bitter almonds (*Louz-el-murr*) are described by Mahometan writers as attenuant and detergent; they are recommended both internally and externally for a variety of purposes. As a plaster made with vinegar they are used to relieve neuralgic pains; as a collyrium, to strengthen the sight; in emulsion with starch and peppermint, to allay cough. They are also considered to be lithontriptic and diuretic, and of use for removing obstructions of the liver and spleen; applied to the head they kill lice; as a suppository they relieve pain in difficult menstruation; as a poultice they are a valuable application to irritable sores and skin eruptions. The root of the tree is described as discutient and alterative; it is used both internally and externally. The gum with that of the plum tree, known in Bombay as "*Badami gond*," is one kind of Hog gum or Gum Bassora of European commerce, and is used in the East as a cheap substitute for more soluble gums. The oil of almonds is not an article of commerce in India.

Description, &c.—For a description of the fruit we may refer the reader to standard botanical works. Persian almonds are inferior in appearance to Jordan almonds; they may be classed with those known in London as Valencia and Sicily. Almonds should have a perfectly bland, sweet, nutty flavour when the outer brown skin has been removed. They contain no starch; the skin is astringent from the presence of tannic matter. Bitter almonds, except in taste, have the same physical characters as sweet almonds.

Chemical composition.—The following represents the mean proximate composition of almonds from analyses by Fleury, König and Kranch:—

Water	5·39	per cent.
Nitrogenous matter	24·18	,,
Fat	53·68	,,
Non-nitrogenous extractive ...	7·23	,,
Cellulose	6·56	,,
Ash	2·96	,,

When dried they contain 56·86 per cent. of fat and 4·08 per cent. of nitrogen. Fleury found that the total amount of sugar, dextrin and mucilage was 6·29 per cent., the last mentioned constituent being present in very small amount. Almond oil is more thickly fluid than poppy seed oil, but more thinly fluid than olive oil, it is clear and odourless, pale yellow in colour, and possesses a very agreeable mild taste. At —10°C. the oil becomes thick, at— 16° C. it assumes a white turbidity, and at — 20° C. it solidifies to a white butter. At 20° C. it has a specific gravity of 0·917 and at 15° C. 0·919. Exposed to air the oil readily turns rancid, and acquires a disagreeable taste and odour, and a higher specific gravity. According to Allen almond oil consists chiefly of triolein, more or less tripalmitin, and probably its homologues being also present; it is also stated to contain traces of cholesterin, and to be thus distinguished from poppy, sesame, rape and olive oil. By pressure sweet almonds yield on an average 45 per cent. of oil, and bitter almonds 38 per cent. (*Brannt.*)

Bitter almonds contain a glucoside called *Amygdalin*, $C^{20}H^{27}NO^{11}$, and a neutral principle called emulsin or synaptose—also a constituent of sweet almonds—which possesses the power of acting as a ferment on the amygdalin in the presence of water, converting it into benzoic aldehyde (oil of bitter almonds), hydrocyanic acid and glucose. By boiling, however, the hydrolytic power of emulsin is destroyed. The presence of amygdalin is not confined solely to bitter almonds, it is present also to a small extent in sweet almonds, and in many plants, chiefly belonging to the Amygdalaceæ, Drupaceæ and Pomaceæ: bitter almonds contain 2·8 to 4 per cent.; peach kernels 2·35 per cent.; cherry kernels ·82 per cent.; plum kernels ·96 per cent.; and apple pips ·6 per cent. Amygdalin also occurs in other parts of these plants; also in the leaves of the *Cerasus Laurocerasus*; in the bark, flowers, and leaves of the *Prunus Padus*; in the seeds and bark of *Sorbus Aucuparia*, in the hawthorn, &c. All these portions of the plants yield oil of bitter almonds, containing hydrocyanic acid on distillation with water. The shrubby members of the *Spiræa* family yield a distillate which contains hydrocyanic acid, but it has not been decided whether the hydrocyanic acid thus yielded is derived from amygdalin. Similar remark also apply to the hydrocyanic acid present in the sap of the bitter cassava, from which arrowroot is prepared: in the *Chardenia eranthemoides*, in the fruit of the *Ximenia americana*, in *Ipomœa dissecta* and *Agaricus oreades*, while the seeds of the *Vicia sativa*, which do not contain amygdalin yield both benzoic aldehyde and hydrocyanic acid, benzoic aldehyde being also found in the germinating seeds of cross. According to Frerichs and Wöhler amygdalin is not poisonous: but Moriggia and Ossi assert that the principle exerts a poisonous action, even in the absence of emulsin, especially on graminivora. (*Ber. Deutsch. Chem. Ges. IX.* 198.) being also found in the germinating seeds of cress. Benzoic aldehyde or oil of bitter almonds is prepared on the large scale by distilling with water the residue of bitter almond cake left after expression of the fixed oil, the yield being ·9 per cent. on the pressed residue, while on the large scale the amount is ·74 to 1·67 per cent., or ·42 to ·95 parts per 100 of unpressed bitter almonds, the variations in yield being attributed chiefly to the varying amount of amygdalin present. The crude oil of bitter almonds contains, according to Brannt, 13 per cent. of anhydrous hydrocyanic acid. When pure it is colourless, and has a specific gravity at 15° C. of 1·0430.* For further particulars regarding the chemistry of the principles present in bitter almonds, we would refer the reader to Watt's *Dictionary of Chemistry*, 2nd Edition, and to Roscoe and Schorlemmer's *Treatise on Organic Chemistry*, from which sources the greater part of our information has been abstracted.

Commerce.—Almonds are imported into Bombay from the Persian Gulf in large quantities (16,000 to 20,000 cwts. annually). Value, Abushahrí, Rs. 4 per Surat maund of 37½ lbs.; Kaghazí (thin shelled), Rs. 12; Bunderí, of handsome appearance but having small kernels, Rs. $3\frac{7}{8}$; Asmaní, Rs. $3\frac{6}{8}$. Almonds are also largely imported into India from Cabul.

In addition to bitter almonds, the natives of the East use the following drugs which yield hydrocyanic acid:—

Prunus Mahalib, *Linn.*, Gávala or Gahúla (*Indian*), Mahalib (*Arab.*), Paiwand-i-miryam (*Pers.*), a native of Central Asia and Europe, and the Quénot or Malague of the French. The kernels.

Prunus Pudum, *Roxb.*, Padma-káshtha (*Ind.*), a native of Central Asia. The bark.

Prunus sp.? Alúbálú (*Ind.*). The stones.

The first drug consists of small almonds of a pale buff colour, the skin is thin and marked with longitudinal veins; amongst them a few entire stones may be found, these have very fragile

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shells of a pointed oval shape, about $\frac{4}{10}$ of an inch long and $\frac{2}{10}$ broad. The almonds when chewed have a strong flavour of hydrocyanic acid; they are the محلب (Mahalib) of the Arabian physicians.

The second drug consists of the smaller branches of the tree, usually $\frac{3}{4}$ of an inch or less in diameter, but sometimes much larger, the bark of which evidently contains amygdalin. It is described as cooling and tonic.

The third drug has exactly the appearance of common cherry stones, the kernels of which contain the elements of hydrocyanic acid. It is the *κεράσια* of the Greeks and the آلوبوعلي (Alú-búali) of Mahometan writers on Materia Medica, Alúbálu being an Indian corruption of the name. Mahometan physicians describe these drugs as strengtheners of the nervous system, and antilithics.

PRUNUS INSITITIA, *Huds.* var. bokariensis.

The Bokhara plum (*Eng.*).

Hab.—Central Asia. The dried fruit.

Vernacular.—Alu-bokhára (*Ind.*), Alpogáda-pazham (*Tam.*), Alpogáda-pandlu (*Tel.*).

Description, Uses, &c.—The Bokhara plum in a dry state is commonly met with in Indian bazars, being used much as prunes are with us in Europe. It may be considered the officinal prune of India, and may be made use of in the preparation of confection of Senna, and for any other purpose to which prunes are applicable. The author of the *Makhzan-el-adwiya*,* after noticing several kinds of plum which are common in Persia and the neighbouring countries, goes on to say that for medicinal purposes the amber-coloured Bokhara plum is to be preferred. He describes it as sub-acid, cold and moist, digestive and aperient, especially when taken on an empty stomach, useful in bilious states of the system and heat of body. The root, he says, is astringent, and the gum a substitute for Gum Arabic, and often called Persian gum

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* Conf. Makhzan, article اجاص

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He also notices the wild plum (probably *P. spinosa*), and says that a kind of dry cake is prepared from the pulp, and used medicinally on account of its acid and astringent qualities; and an astringent kind of plum from Damascus which the Turks call Fakúmílás, evidently a corruption of the Greek κοκκυμηλέα, see Dioscorides (i., 142) and Theophrastus (H. P. IV. 2, 10), who describe prunes as coming from Damascus. Pliny mentions twelve kinds of plum (15, 12), and also notices the medicinal use of the leaves as an astringent and the fruit as an aperient. (23, 66.)

The Bokhara plum as met with in commerce is about the size and shape of the dry prune of Europe, but of a lighter colour, the skin having been removed; it is very acid, but on the addition of a little sugar the taste is agreeable and refreshing. Prunes contain free malic acid, sugar, and albuminoid and pectic substances; what the supposed laxative principle is has not been determined.

Chemical composition.—The dried Bokhara plum as sold in the bazars, deprived of seeds, has the following percentage composition:—

Moisture in vacuo over sulphuric acid	6·24	per cent.
Ash	3·39	,,
Extractive matter soluble in boiling water	74·10	,,
Ash in extractive matter	4·58	,,
Principles precipitated by absolute alcohol from aqueous extract	12·68	,,
Ash in absolute alcohol precipitate.	·226	,,
Saccharine matter possessing a reducing action on alkaline copper solution, without previous ebullition with acids	44·63	,,
Total free and combined citric acid	3·05	,,
Total free and combined malic acid	1·98	,,

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The total alkalinity of the ash expressed as KHO was equal to 61·76 per cent. calculated on the ash: the alkalinity of the aqueous extractive ash calculated in a similar manner being equal to 44·44 per cent. of KHO. The total free acidity of the fruit expressed as Na HO was equivalent to 3·80 per cent.

Commerce.—The imports of Alú Bokhárá into India are considerable, as it is much used as an article of diet. Value, Rs. 8 to 12 per Surat maund of 37½ lbs. The price varies with the quantity in the market; there is but little difference in quality.

HAGENIA ABYSSINICA, *Lam.*

Fig.—*Bentl. and Trim. t.* 102.

Hab.—Abyssinia. The flowers.

Vernacular.—Kassu (*Guz.*)

History, Uses, &c.—This drug appears not to have been known in India until within the last quarter of a century, when a demand for it in Europe having sprung up, it began to be imported into Bombay from Abyssinia *viâ* Aden. The use of the flowers as an anthelmintic by the Abyssinians was first made known by Bruce in 1773. In 1811 the plant was described by Lamarck, who named it Hagenia, in honour of Dr. Hagen of Königsberg. The name of Brayera, which it also bears, was given it in honour of Brayer, a French physician of Constantinople, who wrote a pamphlet upon its use as an anthelmintic. In 1850 it was introduced into Europe, and in 1864 it became official in the British *Pharmacopœia.* At the present time the imports into Bombay are declining, and there appears to be very little demand for the drug in Europe. M. W. Schimper, Governor of Adoa, in an excellent article upon Cousso, mentions several other vermifuges used by the Abyssinians—*viz.*, Habbi-tchogo, bulbs of *Oxalis anthelmintica;* Habbi-tsalim, *Jasminium floribundum;* Bolbidá, *Celosia adoensis;* Musenna or Muséna, bark of *Albizzia anthelmintica,* from which M. Thiel has extracted Muséuine; Saoria, seed of

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Mæsa picta or *lanceolata;* Angogo or Ogkert, *Silene macrosolen;* Tatzé or Zareh, fruit of *Myrsine africana.*

Kousso has been employed from time immemorial in Abyssinia for the expulsion of tape-worms, which there prevail extensively. But it is stated by Johnson that its operation is so severe that it often produces miscarriages, and even death, in pregnant women. In Europe it is said sometimes to have occasioned severe colic, but generally its operation is not distressing, and consists only of slight nausea, followed by feculent and then by liquid stools. According to Arena, these differences depend upon an alteration which the resin undergoes by time. Of all the remedies for tape-worm (*Tænia solium, T. bothriocephalus*) none is more efficient or certain, provided that the flowers are fresh, but they deteriorate rapidly. The parasite is generally discharged dead.

The Abyssinian mode of using it is thus described: An infusion is made with water or beer, or the flowers are mixed with honey to the amount of from 4 to 6 drachms, and the whole is taken in the morning, fasting, and no food is eaten during the day. Generally, the worm is discharged in the course of 24 hours without purging, pain, or colic. This description by Aubert and by Engleman, contradicts the one given above. In Europe and in this country an infusion is prepared with 2 drachms of the powdered drug in 4 fluid ounces of boiling water, which, when cold, is drunk without having been strained. Kraus recommends 25 Gm. (ʒvi) in lemonade on an empty stomach, and followed an hour later by castor oil. As its taste and smell are disagreeable, resembling somewhat those of senna tea, it has been proposed to administer the powder in granules made with sugar and swallowed with some aromatic infusion. The following mode of preparing the dose has been recommended: Treat by displacement ½ ounce of kousso in powder with 6 drachms of boiling castor oil and 1½ ounces of boiling water. Express the liquid, and make an emulsion with it and the yolk of egg; add 40 drops of sulphuric ether, sweeten, and flavour with oil of anise. This emulsion should be taken, fasting, at one dose. In all cases the patient should fast the day before using the medicine. (*Stillé and Maisch.*)

Description.—The panicles are about 12 inches long, much branched; axis and branches zigzag, hairy, and glandular, each branch supported by a ciliate sheathing bract; flowers very numerous, ¼ to ⅓ inch broad, each with two large roundish membranous-veined bracts at the base, which are green in the staminate flowers, but become purplish-red in the pistillate flowers; calyx shortly stalked, top-shaped, hairy, and with ten membranous and veined segments arranged in two alternating whorls. The sepals of the outer whorl of the male flowers are greenish-yellow, small, and nearly linear; but in the female flowers they are finally about ⅖ inch long, and much larger than the inner row of sepals, and when fully developed are obovate and of a red color. The five linear petals are inconspicuous and much shorter than the inner sepals, with which they alternate. Stamens between fifteen and thirty, very small and shrivelled in the female flowers, equalling the petals in the male flowers, inserted in the contracted throat of the calyx. Carpels two, or occasionally three, distinct, enclosed in the calyx tube; styles projecting from the tube; fruit a small membranous achene, pointed by the persistent short base of the style, and containing a straight fleshy embryo with two plano-convex cotyledons.

The female inflorescence being most frequently collected, the commercial article should have a pale brownish-red hue, and is often distinguished as *red kousso.* It is collected before the fruit has ripened, and either the entire inflorescence is dried loosely, or before quite dry a number of panicles are formed into cylindrical rolls, measuring about 10 to 20 inches in length, weighing about 4 to 8 ounces and tied by split culms of *Cyperus articulatus*; the loose panicles are usually much broken. The male inflorescence has in the dry state a light greenish-brown colour, and is sometimes known as *kousso-esels.* The odour of both varieties is not strong, but pleasant and tea-like; the taste is gradually developed, mucilaginous, bitterish, acrid, and disagreeable. (*Stillé and Maisch.*)

Chemical composition.—According to Wittstein (1840), kousso contains as principal constituents 6·25 per cent. of a bitter acrid resin and 24·4 per cent. of tannin, consisting of two kinds; he also obtained 15·71 per cent. of ash and some tasteless resin, besides the common constituents, chlorophyll, wax, sugar, and gum. The acrid resin appears to be the medicinally active principle, and has been variously called *brayerin, kwosein, koussin,* and *kosin.* As prepared by Dr. C. Bedall (1872) by Pavesi's process, it was found to be an efficient tænifuge. Kousso is repeatedly treated with alcohol to which slaked lime has been added; the residue is boiled with water, the different liquids mixed, filtered, and distilled, and the remaining liquid treated with acetic acid, which separates about 3 per cent. of koussin as a white flocculent precipitate, becoming denser and resin-like and on drying yellowish or at a higher temperature brown; in larger quantities it has a peculiar odour of Russian leather, a persistent bitter and acrid taste, and is of a distinct crystalline appearance when viewed under the microscope. Dr. E. Merck has subsequently further purified it, probably by crystallizing it from boiling alcohol. Flückiger and E. Bury (1874) describe it as forming yellow rhombic crystals, which are readily soluble in benzol, bisulphide of carbon, chloroform, and ether, less freely in glacial acetic acid, sparingly in cold alcohol, and are insoluble in water; alkalies dissolve it readily and acids precipitate it again; it fuses at 142° C. and congeals to a transparent yellow mass, which when touched with a trace of alcohol is converted into stellate tufts of crystals; its composition is $C^{31}H^{38}O^{10}$, and it is probably an ether of isobutyric acid. M. Liotard regards the active principle as an acid; it combines with alkalies and oxide of lead. Prof. Buchheim found this *pure kosin* to be very inferior in its anthelmintic action.

By distillation with water, kousso yields traces of valerianic and acetic acids and a little solid volatile oil having the odour of the drug and without any tænifuge properties. (*Stillé and Maisch.*)

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ROSA DAMASCENA, *Miller.*

Fig.—*Miller Laur. Ros. t.* 38. Damask Rose (*Eng.*), Rosier de Damas (*Fr.*).

Hab.—Syria. Cultivated in India. The petals, stamens, and essential oil.

Vernacular.—Guláb-ke-phúl (*Hind.*), Guláppu, Irojáppu (*Tam.*), Gulap-phúl (*Beng.*), Roja-puvou, Gula-puvou (*Tel.*), Gulabi-huvou (*Can.*), Gulápha-cha-phúla (*Mar.*), Gulab-nu-phùl (*Guz.*).

History, Uses, &c.—Roses are mentioned by the oldest Greek writers, and among the ancients were sacred to Dionysus and Aphrodite. Under the Romans one of the principal Bacchic festivals was called '*Rosalia,*' and roses were used on all festive occasions. The famous rose gardens of Midas were situated in Macedonia, the modern Bulgaria, still famous for the production of Otto of Roses. The Rose has given rise to innumerable solar myths both in the East and in the West, one of the prettiest being the well-known story of Gul-i-Bakawli. Dioscorides mentions the astringent properties of rose petals, the use of their ash as a collyrium, and the medicinal use of the stamens. The Sanskrit names for different kinds of roses appear to be modern, Satapattri (centifolia) being the name for *R. damascena.* The variety known as the *Bengal rose,* (**R. involucrata**) with a white flower not unlike the English *dog rose* in appearance, is of interest, as its perfume is quite distinct from that of ordinary roses, and is like that of the jargonelle pear, due probably to the presence of amyl acetate.

Pliny (21, 10,) describes twelve varieties of the Rose, and (21, 72,) thirty-two remedies derived from them. Under the name of *Ward* the following kinds of rose are noticed in Arabic and Persian works:—White wild rose, Red wild rose, Red garden rose, Yellow wild rose, Yellow garden rose, Dalik or Dog rose, White cluster rose, and a wild rose called *Ward-el-hamak,* the petals of which are described as yellow outside and red within.

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Of these the red garden Rose appears to be the *R. damascena* which is cultivated both in Persia and India for officinal purposes, and is the kind from which Rosewater and Oil of Roses are usually obtained. In India Rose buds are preferred for medicinal use, as they are more astringent than the expanded flowers; they are considered to be cold and dry, cephalic, cardiacal, tonic and aperient,[*] removing bile and cold humours; externally applied the petals are used as an astringent. The stamens are thought to be hot, dry and astringent, and the fruit is credited with similar properties. Notices of the fruit of *R. canina* will be found in Arabic works under the name of Dalík. The Rose stamens (Tukm-i-gul or Rose-seed) of the shops are supposed to be derived from this plant, but are really those of *R. damascena;* the ancients also called the stamens seed. Pliny says: "In the flower there is the seed as distinguished from the filaments," and again, "As to the seed of the rose the best is that which is of a saffron colour." The following preparations made with the petals of *R. damascena* are used as medicaments:—

Duhn-i-ward-i-khám.—A fatty oil made by exposing Rose leaves and sweet oil to the sun and then filtering.[†]

Duhn-i-ward-i-matbúkh.—A similar preparation made by heating the petals with sweet oil over the fire. Both of these oils are considered to be deobstruent, astringent and aperient; they are also recommended in poisoning by caustic alkalies.

Gulkand.—A conserve made from equal parts of Rose petals and white sugar beaten together; it is considered tonic and fattening, and is much used by women and old people. Ibn Sina says that he cured a consumptive young woman with it. To this preparation *Cannabis indica* is sometimes added in India.

Gulangabín.—A similar preparation made with honey and considered to have much the same properties.

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[*] For an aperient, the dried buds are boiled with rice, and ghi and sugar are added.

[†] The *ῥόδινον ἔλαιον* of the Greeks. Conf. Dios. i., 44.

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Guláb.—Rosewater is largely used in native practice in much the same way as orange flower water is by the French.

Guláb-ka-attar.—Otto of Roses, having properties similar to those of Rosewater, is made in Persia and India; but not in sufficient quantity to supply the Indian market; a good deal has therefore to be imported from Turkey. Rosewater is manufactured in Bengal and the Punjab, and a large quantity is imported from Persia. An account of the preparation of Rosewater and otto at Gházípur in Bengal will be found in the *Bengal Dispensatory.* It appears that the common native still is used (this is simply a rough form of alembic without a condensing worm), and that one hundred thousand roses produce about 100 bottles of Rosewater. Otto is only made in cold weather. To obtain it the Rosewater is exposed to cold in shallow vessels, a thin film forms upon the surface, and is removed with a feather. One hundred thousand roses are estimated to produce about 180 grains of otto. Otto is said to have been first discovered in India by Núr-i-jehán Begum, A.D. 1612. On the occasion of her marriage with the Emperor Jehángír, the Queen is said to have observed a scum upon the surface of the Rosewater with which the canals in the gardens of the palace had been filled, and ordering it to be collected found it to have a delicious fragrance. For an interesting history of otto and its introduction into Europe the *Pharmacographia* may be consulted. Colonel Polier (*As. Res. i.*, 332), who describes the process of preparing otto in India, as conducted by himself, says:—"The colour of the *attar* in different years varies greatly when obtained from roses grown on the same ground. Emerald-green, bright yellow, or reddish attar is often seen. The calyx may be left, as it does not affect the quality of the oil, or impart any colour to it. The yield in the most favourable seasons is 3 drachms per 100 lbs. of rose leaves.

Description.—*R. damascena* is a shrubby plant, with numerous unequal strong prickles, dilated at the base; leaflets 5 to 7, ovate, stiffish; flower-bud oblong, sepals deflexed after the flowers have opened; tube elongated, often dilated at the top; fruit ovate, pulpy; calyx and peduncles glandulosely hispid, viscous; colour of flower light red.

Chemical composition.—Pure oil of roses carefully distilled is at first colourless, but quickly becomes yellowish. Its specific gravity at 22°·9 C. is ·870 and its boiling point 228°·8 C., it solidifies at 11°·1 to 10°·1 C., and is soluble in absolute alcohol and in acetic acid. (*Brannt.*) Rose oil is a mixture of a liquid constituent containing oxygen, and a hydrocarbon or stearopten, $C^{n} H^{2n}$, which is not altered by boiling with alcoholic potash, and which is entirely destitute of odour. From the Turkish oil it may be obtained to the extent of 12 to 14 per cent., in the German oil it is present to the extent of 32 to 34 per cent. The liquid portion of Rose oil has not yet been obtained entirely free from the stearopten. To isolate the stearopten, Messrs. Schimmel heated fifty grams of oil with 500 grams of 75 per cent. spirit to a temperature of 70° to 80° C., upon cooling, the stearopten separated almost entirely. It was then removed from the liquid and treated similarly with 200 grams more of 75 per cent. spirit, and this operation was repeated until the stearopten was obtained perfectly odourless.

Rose oil, from which the stearopten has been removed in the above described manner, is perfectly liquid at 0° C.; but when placed in a cooling mixture it solidifies to a gelatinous mass, showing that it is not quite free from stearopten. This liquid oil is described as having an extraordinarily fine and powerful odour, and as presenting the advantage that when used dissolved in spirit it does not give rise to any crystalline separation.

If cautiously melted by the warmth of the sun, the stearopten forms on cooling microscopic crystals of very peculiar shape. Most of them have the form of truncated hexahedral pyramids, not however belonging to the rhombohedric system, as the angles are evidently not equal; many of them are oddly curved, thus §. Examined under the polarizing microscope, these crystals from their refractive power make a brilliant

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object. (*Messrs. Schimmel & Co.'s April Bericht,* 1889; *Pharmacographia.*)

Adulterations.—According to Brannt, the most usual and reliable tests of the quality of Rose oil are: its odour, its congealing point, and its crystallization. Much of the Persian Rosewater is diluted with water in Bombay before it is sold. Pure otto is hardly to be obtained; it undergoes adulteration before it is shipped to Bombay, and on arrival is still further falsified by a large admixture of Sandalwood oil, reducing its value from Rs. 16 to Rs. 2 per tolá. In the preparation of adulterated otto in India Sandalwood chips are added to the roses in the still.

We have been unable to ascertain that otto is ever adulterated with Rusa grass oil in India, nor do the dealers in the latter article appear to know anything about its use in Turkey for this purpose.

Commerce.—The Indian market is supplied with dry Roses from all parts of the table land; both buds and expanded flowers arrive together, and are valued at about Rs. 4½ per Surat maund of 37½ lbs. The buds are separated and sold for Rs. 7 per maund. The expanded flowers are worth only Rs. 3 per maund, and are purchased for the preparation of Gulkand. Rosewater, to the extent of 20,000 to 30,000 gallons annually, is imported into Bombay from the Persian Gulf; two qualities are met with, Yak-atishi (once distilled) and Du-atishi (twice distilled). Value, Rs. 4 to Rs. 4½ per carboy of 20 lbs.

Otto of Roses is imported from Persia and Turkey, and a small quantity is made in India. In Bulgaria, which is the chief seat of manufacture, it is packed in squat-shaped metal flasks holding from 1 to 10 lbs., sewn up in white woollen cloths. Their contents are frequently transferred at Constantinople into small gilded bottles for export. The value of an average harvest is from $3,500,000 to $4,500,000. (*Brannt.*)

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PYRUS CYDONIA, *Linn.*

Fig.—*Bentl. and Trim., t.* 106. Quince tree (*Eng.*), Coignassier commun (*Fr.*).

Hab.—Central Asia, cultivated in all temperate climates. The seeds.

Vernacular.—Bihi-danah (*Hind., Guz., Mar.*), Shimai-madalaivirai (*Tam.*), Shima-dálima-vittulu (*Tel.*), Shime-dalimbabija (*Can.*).

History, Uses, &c.—The quince was called by the Greeks *Chrysomela* and by the Romans *Malum aureum;* it was sacred to Venus. Plutarch states that it was a popular custom for the bride to eat a quince before mounting the nuptial couch. Virgil in his third Eclogue has an allusion to this custom :—

> Malo me Galathea petit, lasciva puella,
> Et fugit ad salices.

According to Mattioli (*De Plantis*) it is considered in Spain to be an antidote to Hellebore. (*Gubernatis Myth. des Plantes.*) The author of the *Makhzan* describes three kinds of quince (*Safarjal*)—the sweet, the sour and subacid, called in Arabic *Muzz.* The sweet and subacid quinces are commonly eaten as a fruit by the Arabs and Persians, and are considered cephalic, cardiacal and tonic; they are also eaten baked. The leaves, buds and bark of the tree are domestic remedies among the Arabs on account of their astringent properties. In Persian *Karabádíns* (Pharmacopœias), a number of receipts for making conserves, lozenges, &c., of the fruit, as well as a conserve of the flowers, will be found.[*] In India we only meet with the seeds as an article of commerce. They are considered cold, moist, and slightly astringent, and are one of the most popular remedies in native practice, the mucilage being prescribed in coughs and bowel complaints as a demulcent; externally it is applied to scalds, burns and blisters.

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[*] Conf. Dioscorides v., 20, *et seq*, for Quince Wine, Quince honey, &c. κυδωνὶτης οἶνος καὶ κυδωνόμελι; κ.τ.λ. Pliny, 23, 54.

Description.—The quince resembles a pear in shape and size; when ripe it is of a golden yellow colour. The kind commonly cultivated in Europe is sour and astringent, but has an agreeable and aromatic smell. In Arabia and Persia sweet edible quinces are grown, and are commonly offered for sale. In structure the quince differs from the pear in having numerous seeds in each cell, which cohere together by the mucilaginous membrane with which each seed is surrounded. The seeds are irregularly ovoid, flattened and three-sided from mutual pressure. At the lower end is the hilum, from which the raphe extends as a straight ridge to the opposite extremity, which is slightly beaked and marked with a scar indicating the chalaza. The testa is of a dark brown colour, and encloses two cotyledons and a straight radicle directed towards the hilum. The kernel has the odour and taste of bitter almonds, but the testa is simply mucilaginous.

Chemical composition.—According to the *Pharmacographia* the mucilage of the epidermis is present in such quantity that the seed easily coagulates forty times its weight of water. By complete exhaustion, the seeds afford about 20 per cent. of dry mucilage, containing considerable quantities of calcium salts and albuminous matter, of which it is not easily deprived. When treated with nitric acid, it yields oxalic acid. After a short treatment with strong sulphuric acid it is coloured blue by iodine. Tollens and Kirchner (1874), assign to it the formula $C^{18}H^{28}O^{14}$, regarding it as a compound of gum, $C^{12}H^{20}O^{10}$, and cellulose, $C^{6}H^{10}O^{5}$, less one molecule of water. Quince mucilage has but little adhesive power, and is not thickened by borax. That portion of it which is really in a state of solution, and which may be separated by filtration, is precipitable by metallic salts or by alcohol. The latter precipitate after it has been dried is no longer dissolved by water either cold or warm. Quince mucilage is, on the whole, to be regarded as a soluble modification of cellulose. Gans and Tollens show that quince mucilage yields furfuraldehyde on distillation with dilute sulphuric acid, indicating the presence of arabinose or xylose, but no crystalline carbohydrate was isolated. The syrup contains no dextrose or galactose, as neither saccharic nor mucic acid were formed on oxidation. (*Journ. Chem. Soc.*, May 1889, p. 541.) Lancaster (*Am. J. Pharm.*, xxxi., 198,) obtained 1·6 grm. of crystallized malate of lead from the acid contained in 453 grms. of the fruit. Wöhler (*Ann. Pharm.*, 41, 239,) by distilling ripe quinces with water, obtained a trace of an oily liquid possessing the odour of the fruit, and which he considered to probably contain œnanthic ether. Artificial essence of quinces consists of ethyl pelargonate. The seeds contain about 15 per cent. of a very mild oil (*Brannt*), and according to Warnecke, yield 3·55 per cent. of ash, possessing the following percentage composition: Potash 27·09, soda 3·01, magnesia 13·01, lime 7·69, phosphoric acid 42·02, sulphuric acid 2·67, silica ·75, peroxide of iron 1·19, chloride of sodium 2·57. (*Kensington.*)

Commerce.—Quince seeds are imported into India from Afghanistan, Persia, and Cashmere. Value, Rs. 10 to Rs. 25 per Surat maund of 37½ lbs., according to quality.

The imports from Cashmere are valued at Rs. 7,000 yearly.

Anchanchak or **Anjukak.**—Under these names the seeds of the wild pear of Persia (*Pyrus communis*, Linn.,) are sold in the Indian bazars; they are much larger than those of the cultivated tree. Aitchison (*Botany of the Afghan Delimitation Commission*) remarks: "In the Badghis I came upon a small forest of Pear-trees, which I thought might have been the remains of an old orchard, but I was informed that this was not the case. The tree is well known as a wild one. It is called *amrucha* from the small fruit it bears, this being a diminutive for *amrud*. The fruit is dried, ground into a flour, and mixed with ordinary wheat flour." The seeds are eaten and are considered to be very strengthening.

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AGRIMONIA EUPATORIUM, *Linn.*

Fig.—*Wallroth Beiträg. Bot.* 1. 54, *t.* 1, *f.* 9; *Camb. in Jacq. Voy. Bot.* 55, *t.* 68. Agrimony (*Eng.*), Aigremoine (*Fr.*).

Hab.—Temperate Himalayas, Persia, Europe. The herb and fruit.

Vernacular.—Shajrat-el-barághis, Shaukat-el-muntinch (*Arab.*)

History, Uses, &c.—This herb is the ἐυπατωρίον of the Greeks Dioscorides (iv., 39) describes it as having inverted fruit, so rough and bristly that they adhere to the clothes when ripe. The fruit and herb was used both externally and internally as an aromatic astringent. Pliny (25, 29) says:—"The Eupatoria also is a plant under royal patronage (Eupator Mithridates, king of Pontus), the stem is ligneous, hairy, and swarthy, a cubit or more in length. The leaves are arranged at regular intervals and resemble those of cinquefoil (Potentilla) or hemp; they have five indentations at the edge, and are swarthy like the stem and downy. The root is not used. The seed taken in wine is a sovereign remedy for dysentery." *A. Eupatorium* appears to have been known to the Western Arabs under the names of Shajrat-el-barágith and Shaukat-el-muntineh, and latterly as Gháfith or Kháfil. Ibn Sina and the Eastern Arabs and Persians adopted a Persian plant called غافث (Gháfat) as representing the Eupatorion of the Greeks, and describe a plant having the foliage of Agrimony but with a long dark-blue flower. This plant is still sold in the East under the name of Gháfith or Ghásis, and is *Gentiana Olivieri*, Griseb., which Aitchison observed growing in such profusion on the sandy downs of the Badghis as to give a blue colouring to them. It is called *Gul kalli* by the Persian peasants from its being used to cure كلى (kallí) or ringworm of the scalp in children. The Hindus do not appear to be acquainted with the medicinal properties of Agrimony, but it is still used in Europe as a popular astringent and stimulant in gargles for

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sore-throat and as a wash to sores. Agrimony tea is used as a domestic remedy for dyspeptic conditions with derangement of the bowels, and also hot to induce perspiration in febrile affections. According to Nicholson (*Med. Times and Gaz.*, 1879, *p.* 367), Agrimony is an efficient tæniacide when given pounded to a pulp, and followed several hours afterwards by a dose of jalap, and also an active diuretic and antiscorbutic. The plant contains 4·75 per cent. of tannin, a fragrant yellow volatile oil, a bitter principle, and a yellow colouring matter, which has been used as a dye.

Bintafalun.—All Indian Mahometan works on Materia Medica contain lengthy descriptions of the virtues of بنطافلن, the πεντάφυλλον or cinquefoil of the Greeks, which is generally identified with *Potentilla Tomentilla*, Sibth., a plant the roots of which were formerly much used in medicine on account of their astringent properties, and which the old physicians considered to have a peculiar action upon the acidities of the stomach and bowels, and to cleanse them from the slimy mucus and sordes with which they were supposed to be loaded. The drug is not obtainable in the bazars, but Dr. Stewart has observed that the roots of *P. nepalensis*, Hook., are used as a substitute for it in the Punjab, and Murray records the use of *P. supina*, Linn., in Sind. *P. nepalensis*, like *P. Tomentilla*, contains tannin and a red colouring matter.

COTONEASTER NUMMULARIA, *Fisch et Mey.*

Fig.—*Trans. Lin. Soc., 2nd Ser. Botany, Vol. iii., Pt. I., Pl. IX.*

Hab.—Persia. The manna.

Vernacular.—Siah-chob, Kashiru (*Pers.*). The manna, Shirkhisht, Shirkhushk (*Pers.*).

History, Uses, &c.—Mir Muhammad Husain remarks in the *Makhzan-el-adwiya* that Shirkhisht or Shirkhushk is not, as is generally stated, a honey dew which falls upon certain trees in Khorasan; but is an exudation from a tree

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called *Kashira* by the villagers of that province, a small tree with yellow and white mottled wood, which is much valued for making walking-sticks. The Persian name Shirkhushk signifies "dried milk." Aitchison describes Cotoneaster as a tall shrub or small tree common on all the hills of the Paropamisus range, where there is moisture at 4,000 feet altitude. He says the stems are esteemed for walking-sticks and for handles to agricultural implements. From this shrub a manna called Shirkhisht at a certain season of the year is collected. It is largely exported to Hindustan and Persia. (*Trans. Lin. Soc. 2nd Ser. Botany, Vol. iii., p.* 64.) In India this manna is generally confounded with Gazangabin or Tamarisk manna, both kinds forming one commercial article which is sold under the name of Shirkhisht or Gazangabin. The author of the *Makhzan* describes the manna as readily melting in the mouth with a sweet cool taste; when adulterated with barley flour, as is sometimes the case, it is not wholly soluble. He remarks that the Christians obtain a similar substance from Italy in large quantities, and that in India, in the districts of Behar, Patna, and Bhagulpur, a substance something like manna is prepared by heating the roots of a tree called in Hindi *Katera* over the fire, so as to cause an exudation of juice from the cut ends, which concretes like candy and has the properties of manna. It is called in those parts *Harlálu.* Hakim Mir Muhammad abul Hamid states that he has himself used it as manna.* Manna is much valued in the East, as, in addition to its aperient properties, it is supposed to strengthen the liver, stomach and intestines, and to counteract the hot humours which are liable to be generated in those organs. It is also valued as an expectorant.

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* A sample of manna from an unknown botanical source, sent to Dr. G. Watt from the Central Provinces, was in whitish masses with a stratified crystalline fracture, sweetish to the taste with an odour of ordinary manna. It was soluble in water with a slight opacity, and the solution was not affected by iodine or lead acetate; it had a slight right-handed rotation on polarized light (4·58°), and the reduction it caused in Fehling's solution showed that it contained 5·84 per cent. of glucose. It dissolved in cold sulphuric acid with a red colour, and boiled with hydrochloric acid it afforded a brown solution. Oxidized with nitric acid white crystals of mucic acid were deposited. It began to fuse at 130° and melted at 140° in brown globules. Dissolved in boiling water and the solution cooled, a crop of hard white crystals separated. These crystals did not reduce Fehling, and their solution had no action on polarized light. They melted not below 160°. The mother liquor was very fermentable, abundantly reduced Fehling, and was dextro-rotatory. The white crystals were not efflorescent, and resembled mannite, except that they were not so soluble in water.

Description.—Shirkhisht occurs in small yellowish-white granules about the size of millet seed, mixed with the small ovoid leaves of Cotoneaster. It readily dissolves in the mouth, leaving a sweet cool taste.

Chemical composition.—M. Raby (*Union Pharm., May* 1889, p. 201,) finds it to contain about 8·3 per cent. of glucose, 4·1 per cent. of cane sugar, or an analagous sucrose, and about 50 per cent. of a new sugar, which he proposes to call *chirkhestite.* He separated it by removing the glucose and sucrose by fermentation with beer yeast. Chirkhestite has a composition represented by the formula $C^6H^{14}O^6$, and appears to belong to the mannite group; it is nearly related to sorbite, sorbite melting a little below 100° C. and chirkhestite at 112° C. Sorbite does not affect polarized light, but chirkhestite does, although it appears doubtful whether or no this action is due to impurities. Chirkhestite dissolves in less than half its weight of cold water. (*Pharm. Journ., June 8th,* 1889.)

SAXIFRAGACEÆ.

SAXIFRAGA LIGULATA, *Wall.*

Fig.—*Hook. Exot. Fl. i., t.* 49; *Bot. Mag., t.* 3406.

Hab.—Temperate Himalaya. The rhizome.

Vernacular.—Bat-pia, Popal, Ban-patrak, Dakachru (*Hind.*), Páshánbhed, Pákhánbhed (*Indian Bazars*), Atia, Torongsingh, (*Khasia*), Sohanpe-soah (*Nipal*).

History, Uses, &c.—The rhizome is a well-known Indian drug, and is described by Sanskrit writers under the name of Páshána-bheda or "stone-breaker." It is supposed to dissolve gravel or stone in the bladder, and to act as a

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diuretic in doses of 15 grains. It is also said to be an antidote to opium, to have tonic properties, and to be useful as an astringent in diarrhœa and pulmonary affections. Sometimes it is applied externally as an astringent. In Sind it is rubbed down with honey into a paste, which is applied to the gums of children when teething; if used freely in this way it may do harm by confining the bowels too much.

Description.—The rhizome occurs in pieces 1 to 2 inches long, and about half to one inch in diameter. The external surface is brown, wrinkled and scaly, and bears numerous scars of rootlets, and circular markings. The substance is dense and hard, with a reddish colour. The rhizome appears to have been cut up before drying. The red colour of the sections is only external, as a fresh cut shows the interior to be much lighter, or almost white. Under the microscope there are seen numerous conglomerate crystals and ovoid starch cells. The taste is slightly astringent, and the odour similar to that of tan, but more aromatic.

Chemical composition.—The ethereal extract of the finely powdered rhizome was of a pale brown colour, somewhat crystalline, and contained the peculiar odorous principle of the drug. The aqueous solution of this extract gave inky mixtures with ferric and ferrous salts, and precipitated gelatine solution. The mixture of tannic and gallic acids was shaken up in solution with pure ether, and the supernatant liquor afforded the gallic acid in a pure condition, known by its reactions with strong sulphuric acid and alkalies, and by mixing clear with gelatine. Alcohol removed from the residue of this extract an odorous body of soft fatty consistence, and the remainder of the extract was a wax, melting about 48° C. The wax was insoluble in cold alcohol, but almost entirely dissolved on boiling, separating into a mass of crystalline plates when cooled, not wholly dissolved after prolonged boiling with alcoholic potash, not soluble in cold or hot sulphuric acid; in the latter it first turned red, then melted and blackened; nitric acid decomposed it into a yellow brittle resin.

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The alcoholic extract of the powdered drug contained a large quantity of a tannic acid, with some uncrystallizable sugar. The tannic acid was soluble in hot water and reprecipitated on cooling; its insolubility was prevented by adding ammonia until the cold solution was neutral; neutral plumbic acetate then removed the whole in the form of a reddish-brown sediment. The acid gave a blue-black solution with ferric salts, a precipitate with gelatine, and showed evidence of its glucosidal nature. The acid was very similar to the gallo-tannic acid of oak-galls. The resemblance is very close when comparing their lead salts: gallo-tannic acid leaves 50·00 per cent. of lead oxide, the tannic acid under examination left 50·45 per cent. of oxide as the mean of two fairly concordant estimations.

The filtrate from the lead precipitate, after treatment with hydrogen sulphide, was composed entirely of sugar readily reducing Fehling's solution. No alkaloids or mineral salts were detected.

The aqueous extract contained gum, tannic acid, sugar and a small amount of inorganic salts.

The treatment of the residual powder with a one per cent. soda solution dissolved out some red colouring material and metarabin. On adding acetic acid to the solution, it at once pectinized; this effect was produced also when ferric chloride, iodine in potassium iodide, and sulphuric and hydrochloric acids were added. The pectinization was very remarkable. As it would have required an enormous amount of spirit to cause the precipitate to separate, its estimation would have been attended by a great loss. In the following table, the metarabin, albumen, &c., is the loss on the powdered drug sustained in exhausting it with diluted soda. After prolonged boiling with acid previous to the treatment with soda, the pectinization of the metarabin did not take place when made neutral with acid.

The calcium oxalate was dissolved out by means of five per cent. hydrochloric acid. This salt was in the plant in the form of conglomerate raphides, and its reduction to the form of

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carbonate when the plant was burnt constituted the major portion of the ash, which amounted to 12·87 per cent.

The starch was estimated by conversion into glucose by boiling it with a 1 per cent. hydrochloric acid solution for four hours, and titrating the resulting liquor with Fehling's copper tartrate solution.

The table gives the quantity of the different constituents of the rhizome of *Saxifraga ligulata* as far as they were identified in the foregoing analysis :—

Wax and odorous principle	·92
Gallic acid	1·17
Tannic acid	14·28
Glucose	5·60
Mucilage	2·78
Metarabin, albumen, &c.	7·85
Starch	19·00
Calcium oxalate	11·61
Mineral salts	3·80
Sand	·58
Crude fibre	20·80
Moisture and loss	11·61
	100·00

DICHROA FEBRIFUGA, *Lour.*

Fig.—*Wall. Pl. As. Rar., t.* 213 ; *Bot. Mag., t.* 3046.

Hab.—Himalaya, Khasia mountains, Java, China.

Vernacular.—Basak (*Hind.*), Singnamook (*Bhutan*), Gebokanak (*Lepcha*).

History, Uses, &c.—A shrub of the upper hill forests from 4,000 to 8,000 feet. It was first brought to notice by Loureiro (*Fl. Cochin.* 301), who says :—"It is febrifuge and cures quotidian, tertian, and quartan fevers; if taken in the crude state it usually causes vomiting, but if slowly stewed in wine until the latter has evaporated, it purges the bowels and removes obstructions of the viscera. The natives use a decoction of the leaves which acts more mildly if combined with liquorice; it is not a very safe remedy for old and weak people."

In Cochin-China it is called Cay-thuong-son and Cham-chau. In Sikkim and Bhutan the root in the form of decoction is in general use as a febrifuge amongst the natives; it first acts as an emetic, and is thus supposed indirectly to carry off the fever. It appears to have no active effects, unless taken in large quantity, when it causes vomiting and depression of the circulation.

Description.—The yellow bark of the branches peels off in flakes. The root bark, which is generally made use of in India, is of a light colour, soft and corky in structure and almost tasteless. It occurs in the form of small chips, and has a faint aromatic odour. If chewed it causes a sensation of nausea. The external surface is fissured longitudinally, the internal is smooth and rather waxy.

Chemical composition.—The ethereal extract of the root-bark contains a crystalline glucoside allied to æsculin, which may be termed *Dichroin*. It gives an opal blue colour with soda solution, and dissolves in sulphuric acid, showing a reddish colour by transmitted light, and a fine mauve-blue by reflected light. Bichromate of potassium with sulphuric acid forms an indigo-blue colour, turning yellow on the addition of a few drops of water. With Nessler's reagent it forms an opalescent solution and precipitate. Most of the alkaloidal reagents precipitate it in acid solution, but not when neutral. It gives a purplish colour with ferric salts, and a pink colour with ferrous sulphate.

A second crystalline principle insoluble in water is also present in this extract; it is soluble in alkaline liquids, and appears to be a kind of wax. Dichroa root, differing from other plants of the order, contains no tannin; a small proportion of starch exists in the bark.

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CRASSULACEÆ.

BRYOPHYLLUM CALYCINUM, *Salisb.*

Fig.—*Bot. Mag., t.* 1409; *Hook. Bot. Misc., iii.*, 100.

Hab.—Tropical India. The leaves.

KALANCHOE LACINIATA, *DC.*

Fig.—*Pl. Grasses, t.* 100; *Wight Ic.*, 1158.

Hab.—Deccan Peninsula, Bengal.

Vernacular.—Hemságar, Zakhmhyat (*Hind. Beng.*), Parnabij, Ghaimári, Ghaipat, Aranmaran (*Mar.*), Mala-kulli (*Tam.*), Kalnáru, Haradhachchaka (*Can.*).

History, Uses, &c.—These two plants, as well as **K. spathulata**, *DC.*, a native of the tropical Himalayas, known to the natives of the Punjab as *Talára* and *Haiza-ka-patta*, are called in Sanskrit Asthibhaksha and Parna-vija or "leaf-seed," because their leaves when placed upon moist ground, take root and produce young plants. The leaves slightly toasted are used as a styptic application to wounds, bruises, boils, and the bites of venomous insects. Ainslie, speaking of *K. laciniata*, says: "I can myself speak of their good effects in cleaning ulcers and allaying inflammation." We have seen decidedly beneficial effect follow their application to contused wounds; swelling and discoloration were prevented, and union of the cut parts took place more rapidly than it does under ordinary treatment. The juice of the leaves is administered in doses of ¼ to 1 tola (45 to 180 grains) with double the quantity of melted butter in diarrhœa, dysentery, and cholera; it is also considered beneficial in lithiasis. Corre and Lejanne (*Mat. Med. et Tox. Coloniale*) state that *B. calycinum* is called "*Herbe à mal de tête*" in the Antilles, and is used to cure headache, also that it is a good emollient. They remark that it bears the popular name of "*Langue de femme*" parceque les feuilles séparées de la tige,

donnent naissance à des racines adventives et deviennent le point de départ d'une végétation qui ne s'arrête plus (par allusion sans doute à la difficulté de réfréner............la langue des créoles !

Description.—*B. calycinum* is a tall, fleshy, erect, suffruticose plant, having thick, ovate-crenated leaves, consisting of one large leaflet and two smaller ones; petiole and margin of leaf purple; blossom a terminal panicle of pendulous, tubular, yellowish-red flowers; the leaves have a strongly acid and astringent taste.

K. laciniata has decompound and pinnatifid leaves, the segments oblong-acute, coarsely toothed, upper ones nearly entire; sepals lanceolate-acuminate, spreading; cyme panicled; flowers yellow. *K. spathulata* has the lower leaves commonly 3 to 4 (sometimes 10) inches long besides the petiole; upper leaves (with the petiole) often 3 to 4 inches long by ½ broad, frequently sessile. Flowers clear yellow.

Chemical composition.—The fresh leaves of *B. calycinum* contain in 100 parts:—

Water	89·77
Organic matter	8·72
Mineral matter	1·51

They give up to alcohol chlorophyll, fat, and an organic acid of a yellow colour striking an olive green tint with ferric chloride. Water extracts acid tartrate of potassium, sulphate of calcium and some free tartaric acid. Calcium oxalate occurs in the residual fibrous portion of the leaves.

DROSERACEÆ.

DROSERA PELTATA, *Sm.*

Hab.—Himalayas and Nilgiris, distributed in Malay Archipelago. Peltate Sundew (*Eng.*), Rossolis en bouclier (*Fr.*).

History, Uses, &c.—The Sundews are small herbaceous plants growing in grass land, and are interesting from the fact that their leaves have glandular hairs which close upon flies and insects that rest upon them. Darwin has proved that animal food is digested by these plants, and it increases their vigour of growth, the weight of the plants themselves, and makes them capable of producing more capsules and seeds. They are bitter, acid and caustic, and applied to the skin cause pain and inflammation. Their blistering properties are known at Madura, and Madden has reported the same effects at Kunawar; Stewart, however, in *Punjab Plants* was not acquainted with these plants west of the Sutlej. The powdered leaves mixed with salt and applied to the arm with a waterproof covering produced a purplish-red coloration, and after three hours caused such pain that the poultice had to be removed. On the fifth day inflammation set in and the skin became most tender; on the eighth day it blistered without any inconvenient symptoms, and on the ninth day the coloured skin burst and was removable in a few hours afterwards. On the Continent trials have been made with the alcoholic extract of *D. rotundifolia* in cases of phthisis with apparently favourable results, while some physicians have remarked that it is too acrid, drying and hot to be serviceable for internal use. Homeopaths consider that in pathogenic doses it causes a spasmodic cough resembling pertussis. The Vytians use the Drosera for reducing gold to powder. The plants are ground to a paste, which is made to cover a sovereign and then enclosed in two small pieces of an earthern pot cemented together with cloth and clay. When dry the whole is placed in the centre of a pile of *ve*[illegible]*tis* (dried cowdung) and thoroughly burnt. After cool the gold is found reduced to powder, and is given in grain doses with ghee or some confection twice a day as an antisyphilitic, alterative and tonic. Droseras are said to curdle milk, but a cold infusion of this plant does not so act.

Description.—*Drosera peltata* is a delicate little plant, of about 3 to 12 inches in height, with subterminal racemes bearing white flowers; leaves long petioled, lunate peltate, and arising from the stem as well as the root. The plants dried upon paper, cloth or wood stain them with a deep-red colour.

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The powder of the freshly dried herb is dark olive green, and has the odour of sour milk.

Chemical composition.—The dried and powdered plants exhausted with alcohol afforded 26·3 per cent. of a deep red brittle residue; the portion of this extract insoluble in water consisted of a crystallizable colouring matter associated with resinous substances. By treatment of the powder directly with ether the colouring matter was removed in a pure condition and in a crystalline form of yellowish-brown prisms. These crystals were slightly soluble in boiling water and acetic acid, and more readily in strong alcohol, benzol, chloroform and ether. The crystals melted above the boiling point of water, and heated on platinum foil gave off green fumes, which condensed on a cool surface as a yellow crystalline sublimate. The solution in alkaline liquids was deep violet red, discharged by acids; and a dye bath of the powder in which some silk was immersed produced a fast rich brown tint. There can be little doubt that this colouring matter is related to that obtained by Rennie from the root of *D. Whittakeri* growing in Australia. The result of Rennie's investigation was the separation and analysis of two pigmentary principles of a crystalline nature. The one less soluble in alcohol had the formula $C^{11}H^{8}O^{5}$, which represents a trihydroxymethylnaphthaquinone, and the other more soluble had a lower melting point (164-165°) and an empirical formula $C^{11}H^{8}O^{4}$. The absorption spectrum of the alkaline solution of the former body shows the violet, while that of the latter shows only the red. The blistering property appeared to reside in a resin. The powdered herb left when ignited 11·13 per cent. of reddish ash, containing much iron in the ferric state.

HAMAMELIDEÆ.

LIQUIDAMBAR ORIENTALIS, *Miller.*

Fig.—*Bentl. and Trim.*, *t.* 107. Liquid Storax (*Eng.*), Styrax liquide (*Fr.*).

Hab.—Asia. The balsam.

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Vernacular—Silaras (*Ind*), Neri-arishippál (*Tam.*), Shila-rasam (*Tel.*).

History, Uses, &c.—Liquid storax is prepared in the South Western Districts of Asia Minor by boiling the inner bark of the tree in water and pressing it; a superior kind is said to be obtained by simply pressing the bark before it is boiled. We learn from the author of the Periplus of the Erythrean Sea that as long ago as the first century storax was exported *via* the Red Sea to India.

About this time Silhaka (Silaras) is mentioned as one of the imports at the port of Thana on the Western Coast. It was carried first to this country and afterwards to China by Arab traders in the same manner as myrrh, olibanum, and other odoriferous drugs. Upon the decline of the port of Thana the trade was transferred to Surat, then to Goa, and afterwards to Bombay, where it still continues, the imports averaging from 350 to 360 cwts. yearly. In the trade statistics of the early European traders it is called Rosa Mallas and Rosa Malloes, a name which it still retains, and the origin of which is doubtful, though some suppose it to be identical with Rasamála, the Malay name for *Altingia excelsa*. That the latter supposition is incorrect we think there can be little doubt, as the only Rose malloes known in Bombay is that imported from Europe. The following extracts will, we think, show that the name is of European origin, and has been applied to Liquid Storax incorrectly through a confusion of that substance with the Honey dew or Manna collected from trees, the δροσόμελι of the Greeks and the Ros melleus of the the Middle Ages. Galen, speaking of δροσόμελι says:—"I have sometimes known in summer a large quantity of honey to be found upon the leaves of trees, shrubs and certain herbs."

Ibn Baitar, on the authority of Hubaish, says:—"Rasimilius is a substance which falls upon trees in Khorasan; it is useful in fevers, it moistens the chest, is detergent, &c." The author of the *Makhzan* says:—"Rasimilius is a Greek name for a kind of incense called in Arabic دخان الضرو (Dukhán-el-daru), and

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in Hindi अस्त लोबान (Ast lobán) or Western Frankincense." In another place, speaking of Daru, he says that the Greek name is Fazukus (ζυγος) ?

According to Abu Hanífeh "ضرو (*Liquidambar orientalis*) is of the trees of the mountains, and is like the great oak, having clusters (of berries) like those of the oak, but its berries are larger; its leaves are cooked, and when thoroughly cooked, are cleared away and the water thereof is returned to the fire, and coagulates, becoming like 'Kubaita' (a kind of sweetmeat), and is used medicinally as a remedy for roughness of the chest, and for pain of the fauces." The author of the Tuhfat-el-Muminín says :—"ضرو Darú or Zarú is the name of an Arabian tree like the oak ; its fruit is like that of the بطم Butm (*Pistacia Terebinthus*), but its seeds are larger; the gum of this tree is storax (*Hassi luban*), and has already been noticed. The wood, leaves and fruit are hot and dry, and a decoction with sugar, when brought to the consistence of a syrup by boiling, is used for roughness of the throat and cough. The oil of the seeds is odoriferous and dissolves phlegmatic humours; it is useful in dyspepsia, and in the scabby eruptions of animals." In India it is always called Siláras, and is noticed in Sanskrit works as Silhaka, and described as a product of Turkey. The Hindus use it chiefly for perfuming medicinal oils, but are aware of its pectoral qualities, and occasionally prescribe it. In modern Arabic and Persian works Liquid Storax is called Meahsayelah and Lubní, and is described as the gum or juice of a tree resembling the quince. Three kinds are generally mentioned—viz., 1*st*, that which exudes naturally; 2*nd*, that which is obtained by pressing the bark, and 3*rd*, that which is obtained by boiling it. These three kinds, however, are not at the present time distinguished in commerce in Bombay, though the article may vary in quality considerably. Storax is considered by the Mahometans to be tonic, resolvent, suppurative, and astringent; it is prescribed as a pectoral, and is thought to strengthen all the viscera; applied externally it is supposed to have a similar action upon the parts with which it comes in contact. It is a favourite application to swellings, and in India is much used in orchitis, the inflamed part being smeared with it and then bound up tight in tobacco leaves. The Burmese Storax noticed in the *Pharmacopœia of India* is not known in India. Much interesting information regarding the history and sources of Storax may be found in the *Pharmacographia*.

Description.—We have examined the liquid storax of the Bombay market, and find that it agrees with the description of the drug given by Flückiger and Hanbury, which is as follows:—"It is a soft viscid resin, usually of the consistence of honey, heavier than water, opaque and greyish brown. It always contains water, which by long standing rises to the surface. In one sample that had been kept more than 20 years, the resin at the bottom of the bottle formed a transparent layer of a pale golden brown. When liquid storax is heated, it becomes, by the loss of water, dark brown and transparent, the solid impurities settling to the bottom. Spread out in a very thin layer it partially dries, but does not wholly lose its stickiness. When free from water (which reddens litmus) it dissolves in alcohol, spirit of wine, chloroform, ether, glacial acetic acid, bisulphide of carbon, and most of the essential oils, but not in the most volatile part of petroleum (petroleum ether)." It has a pleasant balsamic smell, especially after it has been long kept; when recent, it is contaminated with an odour of bitumen or naphthalin, that is far from agreeable. Its taste is sharply pungent, burning and aromatic.

"When the opaque resin is subjected to microscopic examition, small brownish granules are observed in a viscid, colourless, transparent liquid, besides which large drops of a mobile watery liquid may be distinguished. In polarized light, numerous minute crystalline fragments with a few larger tubular crystals are obvious. But when thin layers of the resin are left on the object-glass in a warm place, feathery or spicular crystals (styracin) shoot out on the edge of the clear liquid, while in the large, sharply-defined drops above mentioned, rectangular tables and short prisms (cinnamic acid) make their appearance. On applying more warmth after the water is evaporated, all the substances unite into a transparent, dark brown, thick liquid, which exhibits no crystalline structure on cooling, or only after a very long time. Among the fragments of the bark occurring in the crude resin, liber fibres are frequently observable.

Chemical composition.—E. Simon (1839) obtained from this balsam styrol, cinnamic acid, styracin, and two resins. In addition to these, W. von Miller (1876-77) found a little benzoic acid, cinnamic ethyl, and a fragrant compound melting at 65° C., probably ethyl vanillin; in larger proportion were found the alcohol storesin in two modifications—the cinnamic ether of this alcohol and cinnamate of phenylpropyl. *Styrol* or *cinnamene* has the composition C^8H^8, and is obtained by distilling storax with water. The yield is very variable. It is a colourless, thin liquid, very refractive to light, and of a very fragrant odour and burning taste. It has been artificially obtained by heating acetylene gas, and from ethyl-benzol bromide by heating it with baryta. Its specific gravity is 0·924, and it boils at 146° C.; but when heated to 200° C. it is rapidly converted into a polymeric compound, *metacinnamene,* which is a colourless, amorphous, tough solid of the specific gravity 1·054, insoluble in alcohol and ether, and reconverted into styrol when distilled. *Cinnamic acid* may be obtained by treating storax with a solution of sodium carbonate and precipitating the acid by means of hydrochloric acid. The ethers are obtained from storax previously deprived of cinnamic acid by treating it with hot petroleum benzin, on the cooling of which white or colourless needles are deposited which require repeated treatment with hot benzin. *Styracin* melts at 38° C., and after prolonged heating congeals to a transparent mass, in which crystals are formed very slowly. It is *styryl* (*cinnamyl*) *cinnamate*, $C^9H^9C^9H^7O^{27}$, and when in alcoholic solution treated with caustic soda, or when heated with an aqueous solution of soda, is converted into cinnamate of sodium and *cinnam-alcohol,* also known as *styryl alcohol* and

This crystallizes in colourless silk

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agreeable hyacinthine odour, melts at 33° C., and boils at 250° C. Styracin and cinnamic acid yield with oxidizing agents oil of bitter almonds and benzoic acid, and when styrol is treated with chromic acid and then boiled with water, benzoic acid is obtained. After saponifying storax with an alkali, and subjecting the alcohols to fractional distillation, Laubenheimer (1872) obtained a distillate having the properties of *benzyl alcohol*; this is a colourless liquid of a weak but fragrant odour having the specific gravity 1·06 and the composition C^7H^8O. *Storesin*, $C^{36}H^{58}O^3$, is amorphous, melts at 168° C. (β storesin at 145° C.), and dissolves readily in alcohol, ether, petroleum, benzin, and potassa, forming with the latter a crystalline compound. Mylius (1882) prepared *styrogenin*, $C^{26}H^{40}O^3$, from that portion of storax which is soluble in boiling benzin; after treating it with an equal weight of sulphuric acid, boiling with water, and washing with ether, white crystals are left which are easily soluble in chloroform, melt at 350° C., dissolve in cold sulphuric acid, being reprecipitated by water, and yield with warm sulphuric acid a yellowish-red solution, which with water precipitates uncrystallizable resin. (*Stillé and Maisch.*)

Commerce.—The imports of this article into Bombay in 1881-82 amounted to 363 cwts. from the Red Sea ports. Value, Rs. 16,154. In India it is often adulterated with coal tar.

Under the name of **Usturak** (*στυραξ*), a bark is sometimes found in the Indian drug shops; it is said to be imported from Turkey, and occurs in half quills several inches long, of a light brown colour, the external surface soft and corky, but the inner portion resinous and aromatic; it is probably the bark of *Storax officinalis*, Linn., the tree which produced the storax of the ancients. (*Cf. Pliny* xii. 55.)

RHIZOPHOREÆ.

These are maritime trees or shrubs popularly called Man-

William Hamilton has published an int

account of them in the *Pharmaceutical Journal*, from which we extract the following:—

"In the economy of Nature the Mangrove performs a most important part, wresting annually fresh portions of the land from the dominion of the ocean, and adding them to the domain of man. This is effected in a twofold manner: by the progressive advance of their roots, and by the aërial germination of their seeds, which drop into the water with their roots ready prepared to take possession of the mud, in advance of their parent stems. The progression by means of the roots is effected by fresh roots, which issue from the trunk at some distance above the surface of the water, and arching downwards penetrate the mud, establishing themselves as fresh plants. Mangrove bogs are certain indicators of a malarious locality, inasmuch as they prevent the escape of unhealthy miasmata."

Rheede (*Hort. Mal. vi., tt.* 33, 34, 35,) figures **Bruguiera caryophylloides, Rhizophora mucronata,** and **Kandelia Rheedii,** and mentions their medicinal use on account of the astringency of their juices. All of these plants are known as Kandel in Malabar, the Portuguese call them Salgeira, and the Dutch Runboom. They contain abundance of tannin, and are used in India by tanners. With salts of copper and iron they yield olive-brown, rust and slate-coloured tints, and are consequently employed in dyeing.

END OF THE FIRST VOLUME.